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HERNIA THROUGH THE ŒSOPHAGEAL ORIFICE OF THE DIAPHRAGM[1]

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HERNIA through the diaphragm, formerly recognized only at autopsy, or on the operating table, is becoming diagnosed more and more frequently by means of X-ray examinations. Thus an abnormal condition, formerly brought to attention through the accident of strangulation or intestinal obstruction, becomes available for the study of symptomatology in the absence of acute emergencies.

If the diaphragm were as accessible for observation as the anterior abdominal wall, varieties of diaphragmatic hernia, with greater individual peculiarities than those which distinguish the inguinal, femoral, and umbilical types, would have long been recognized. At present, by means of X-ray examinations, this separation of diaphragmatic herniæ into varieties of differing prognostic importance to the patient is beginning to be possible. In this way hernia through the œsophageal orifice may be distinguished with relative certainty.

Diaphragmatic hernia may be congenital or acquired. If acquired, it may be traumatic or non-traumatic. It may be a true hernia, contained within a sac lined with peritoneum, the contents of which are thus limited from contact with other structures; or it may be a false hernia, with the viscera composing it passing directly into the pleural cavity. While the presence or absence of a sac may be extremely difficult to demonstrate without operation, it is more than an academic question. It gives a suggestion in regard to etiology. Congenital herniæ when due to an actual failure of development of part of the diaphragm are false. The same is true of traumatic herniæ due to direct wounding of the diaphragm. These varieties occur with preponderating frequency on the left side. The presence of a sac not only limits somewhat the protrusion of abdominal viscera into the thorax, but suggests a slowly developing hernia, at times congenital in origin or possibly secondary to indirect violence but characteristically occurring in herniæ of the non-traumatic acquired type. These true herniæ have a tendency to occur at certain well defined weak areas in the diaphragm. The chief in importance are the œsophageal orifice; the foramina of Morgagni, deficiencies in the diaphragmatic muscle on either side of the ensiform cartilage, through which the deep epigastric vessels pass; and the foramina of Bochdalek, gaps occurring between the costal and lumbar muscular slips on either side, in the embryo a definite opening, the hiatus pleuroperitonealis.

Diaphragmatic hernia in general is characterized by variable and indefinite symptoms, or by a complete lack of symptoms, and by sudden attacks of strangulation and intestinal obstruction. Definite physical find-

[1]Read before the Southern Surgical Association, December 12, 1928.

ings suggesting the condition are unusual. Rarely in large herniæ the presence in the chest of tympany or dullness, absent or diminished breath sounds, displacement of the heart, splashing or the gurgling of peristalsis, may suggest the diagnosis. Or a hernia may be discovered accidentally in the course of X-ray examination for other conditions, either through the presence of gas, or fluid-containing structures above the diaphragm in plates of the chest, or of barium-filled viscera during the course of gastro-intestinal examinations. The final demonstration of diaphragmatic hernia depends on the use of barium, either by mouth or by enema. In this way not only the size and position of the hernia may be shown but what hollow viscera it contains. The only conditions likely to be confused with it are eventration of the diaphragm and thoracic stomach. In the former condition, the thinned and relaxed diaphragm is crowded up into the thorax permitting the abdominal viscera to rise. Diagnosis depends on the X-ray demonstration of the thinned and high-arched diaphragm separating the abdominal viscera from the thorax. In thoracic stomach the diaphragm is in its normal position; the stomach, however, is partially or completely intrathoracic, and the œsophagus is correspondingly short.

All the abdominal viscera, except organs situated in the pelvis, have at one time or another been found above the diaphragm in a hernia. The important structures from a surgical point of view which may be found there are the stomach, the colon, particularly its transverse part, and the small intestine. The stomach, although it may become incarcerated, in part at least, above the diaphragm, is hardly likely to become strangulated. Intestine, however, may become obstructed and strangulated with all the dangers which go with it. The urgency of operation in diaphragmatic hernia, in the absence of obstruction, therefore, depends on the contents of the hernia, which can be shown on X-ray examination. If the hernia contains stomach only, the advisability of operation depends on the symptoms produced rather than on the dangers to the individual.

Hernia through the œsophageal orifice of the diaphragm is commonly considered a rare condition. Hedblom states that in 163 cases operated upon since 1907, the hernia was at the œsophageal orifice in 33. Woolsey found that of 106 cases occurring in civil life since 1900, hernia at the œsophageal orifice, which he classed as acquired, occurred in 17. Harrington found that in 17 of 51 cases of diaphragmatic hernia at the Mayo Clinic since 1908, the diagnosis of hernia of the cardiac end of the stomach through the œsophageal opening was made by means of the Roentgen-ray. He states that this is the most common type of hernia that occurs in adults. In 1924, Morrison reported 42 cases, recognized on X-ray examination, in a series of about 3,500 gastric cases studied, or in a little over 1 per cent. A year later Healy summarized 53 cases, varying in size from an English walnut to a grape fruit, from the same office. Morrison (6) now writes me that he has observed over 130 cases. He has seen only one case in which there was a hernia of the bowel as well as the stomach, and in this case he was unable to convince himself that the hernial sac passed through the œsophageal hiatus. He believed that it went through a slit in the diaphragm just to the left. Bevan has reported a case of hernia through the œsophageal opening which contained transverse colon.

Since 1922, I have customarily felt of the œsophageal ring in the diaphragm as a part of exploration of the upper abdomen. It commonly admits the tip of a finger. A pouch admitting two, three, or four fingers is not an unusual finding. While I have no figures to offer, my observations confirm those of Morrison in regard to the frequency of this condition.

We have, therefore, the apparent contradiction of a condition for which operation has been rarely performed and yet which may be observed not infrequently on X-ray examination. I believe that this is explainable on the ground that these patients rarely get into serious difficulties. The reason that the hernia is not more frequently found is that the stomach is only occasionally present in the sac, slipping in and out of it, according

to the degree of intra-abdominal pressure and of gastric tension. On this account the hernial sac is rarely visible in films of the thorax unless barium is administered. Even if barium is given, the hernia will probably not fill, if examination is carried out in the upright position only. At autopsy the hernial pouch is likely to be overlooked, unless it happens to contain stomach at the time.

Morrison's results depend on special skill in the examination of this region and on a definite search for a hernia, the presence of which he is able to suspect through the recognition of suggestive symptoms. He observed a gas bubble above the diaphragm in only 4 of the 42 cases. He states that in nearly all hernia cases, there is a delay in the œsophagus with slight dilatation. After the barium is ingested an attempt to fill the hernia by pressure is only occasionally successful. Fluoroscopic examination is carried out on the horizontal table in the supine position. In all his series, the cardio-œsophageal opening was patent. The hernia will usually fill, if present, on turning the patient into the left oblique position and directing him to take a long breath. At times, turning the patient into other positions is necessary. The Trendelenburg posture is sometimes helpful.

We may conclude, therefore, that hernia of the stomach through the œsophageal orifice of the diaphragm is not an extreme rarity and is the most common form of acquired diaphragmatic hernia. This type of hernia will probably be shown with increasing frequency on X-ray examinations, particularly if a search is made for it.

What should be our attitude when such a hernia is shown to exist? This will be modified, of course, by the contents of the sac. If X-ray examination by barium meal and enema shows it to contain stomach only, strangulation is improbable, and the risk to the individual is not great. Operative treatment, therefore, is not necessary as a life-saving measure and will depend on the severity of the symptoms which accompany the hernia.

Since 1922 I have operated on 5 cases of hernia through the œsophageal orifice, in which the diagnosis was made previous to operation. The symptomatology and treatment may perhaps be better discussed after presenting these cases.

CASE 1. A single woman of 53 entered the hospital, October 4, 1922, through the emergency ward, on account of an acute attack of abdominal pain. For about 20 years she had suffered from "indigestion," characterized by irregular attacks of gastric distress, coming on an hour or two after eating—belching, pyrosis, and occasional attacks of sharp pain radiating through to the back, accompanied by nausea and vomiting. She had never been jaundiced. Five days previously she was waked at night by severe pain in the epigastrium, radiating to the back, temporarily relieved by morphia, but recurring next day and confining her to bed. This attack was associated with anorexia and slight fever. The remainder of her personal history was not important. There was no story of difficulty in swallowing.

Examination showed a slightly jaundiced woman in good general condition. In the right upper quadrant of the abdomen local tenderness and definite spasm were present. Temperature, pulse rate, and leucocyte count were normal.

The diagnosis was subsiding acute cholecystitis. On account of the long history of digestive disturbance, a gastro-intestinal X-ray was taken. This showed no organic lesion in the stomach, duodenum, or small bowel. When the patient was lying on her back, on deep inspiration a pouch-like bulging was seen just above the cardia, apparently above the diaphragm. It was more pronounced while the patient was drinking. The appearance suggested either an œsophageal pouch or a small hernia of a portion of the stomach through the œsophageal opening.

Operation in this case was clearly indicated by the duration of the symptoms and the evidence of acute cholecystitis. Operation was performed under ether, on October 19, 1922, through a right rectus incision over the gall bladder. The gall bladder was found thick walled and slightly œdematous. No gall stones were felt. The head of the pancreas was somewhat thickened. There were no stones in the common duct. At the œsophageal orifice, there was a purse-like hernia sac about 1.5 inches in diameter, with a ring of about 1 inch. The stomach and duodenum were negative. The abdomen was otherwise negative. A cholecystectomy and an appendectomy were done.

The patient made an uninterrupted postoperative recovery. When seen a year later she had been working constantly since 5 weeks after the operation. She had been completely relieved of her digestive disturbances and abdominal pain.

On October 11, 1928, patient stated that she was very well and was able to eat anything without distress. However, direct questioning brought out that occasionally she had regurgitation with a taste of food occurring during the day or sometimes at

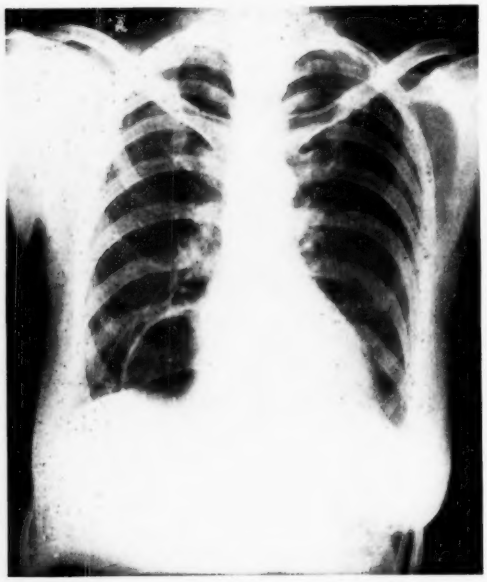

Fig. 1. Case 2. Gas bubble in stomach and hernial sac, visible above the diaphragm. This significant finding is rarely observed in herniæ through the œsophageal orifice.

3 a.m. On eating dry food rapidly, she occasionally had distress under the lower sternum, "like forcing something through a small tube."

A report of the X-ray examination, December 8, 1928, follows: "With the patient in the erect position no evidence of diaphragmatic hernia could be demonstrated. When the patient lay on her back no evidence could be seen at first, but on turning her on her left side, a portion of the cardiac end of the stomach entered the thoracic cavity. This appeared to be somewhat smaller than an orange in size."

The discovery of the hernia was entirely dependent on the X-ray examination with barium; without it, this case would be classed as an excellent result from cholecystectomy. Closure of the hernia would have increased the operative risk, and the result 6 years after operation suggests that even if successfully carried out, it was not a necessary procedure. Knowing the diagnosis, it is now possible to recognize symptoms arising from the hernia. During the past 6 years, the hernia has apparently increased very little in size.

Case 2. A married woman of 52 years entered the medical service, April 28, 1927, complaining of epigastric distress of a year and a half duration, occurring after meals, relieved by belching. Six years previous to entry she had been operated on for recurrent sharp pain, which had been entirely relieved by removal of the gall bladder containing six stones. Her distress came on about half an hour after meals and consisted of a feeling of epigastric fulness, accompanied by sharp pain between the scapulæ. These symptoms were relieved by soda and belching and were apt to appear if she was fatigued or if she went too long without eating.

She was placed on liquid diet and had all her teeth extracted without benefit. On this regimen she lost weight from 158 to 110 pounds and eventually was confined to bed. On a more liberal diet her symptoms gradually disappeared until 2 days before admission when they recurred with severity. There had been no vomiting and no bloody or tarry stools had been observed. At times she had observed and felt peristaltic movements across the upper abdomen. There had been no chest pain, and no difficulty in swallowing had been noted.

Examination showed an undernourished, slightly pale woman with lordosis, narrow costal arch, and scaphoid abdomen, which was negative to palpation. The heart was slightly enlarged; the chest otherwise essentially negative. Gastric analysis showed considerable stasis and increased hydrochloric acid, but no blood. A strongly positive guaiac test was found in the stools. She had a moderate secondary anæmia. The urine was negative.

The report of an X-ray examination taken on April 9, 1927, was as follows: "Occupying the position of the cardiohepatic angle is a circular shadow, apparently liquid, in a cavity filled with gas. The barium is swallowed. The œsophagus seems to be deviated to the right in its lower third and also displaced considerable posteriorly. The stomach contains nearly all the barium meal at the end of 6 hours. When the patient lies on her back the barium flows into the circular area above the right diaphragm, which appears to be a large pouch connected by a narrow isthmus with the body of the stomach. The stomach is large, dilated, and atonic. At times there are brief moments of fairly vigorous peristalsis. The duodenal cap is constantly deformed. A small amount of barium is in the small intestine; none has reached the cæcum."

The diagnosis was obstructing duodenal ulcer with diaphragmatic hernia of the stomach through the œsophageal opening. In view of the symptomatology, the loss of weight, and the definite obstructive duodenal ulcer, operation was advised, particularly since the patient seemed a reasonably good risk. Since the duodenal lesion had to be dealt with, operation was necessarily by the abdominal route.

Operation was performed on May 6, 1927, under ether anæsthesia. A median incision was made from the ensiform to below the umbilicus. The patient was hyperextended and the feet lowered. This gave a good exposure of the diaphragm. The

stomach was very large. In the region of the pylorus there was a tumor about the size of a lemon, firmly adherent to the liver. Regional glands were not enlarged and there was no visible metastasis. The tumor felt like carcinoma, but may have been ulcer. The hernial opening was about 4 centimeters in diameter at the œsophageal opening and contained stomach. This was readily delivered and found to consist of the anterior wall of the fundus of the stomach which had rotated to the right and entered the hernial sac. This had brought the spleen very close to the œsophageal opening. The opening through the diaphragm was closed by transverse interrupted sutures of chromicized catgut, the lower suture including the peritoneum over the œsophagus. The tissues were firm and made a very good closure. A posterior gastro-enterostomy was then done.

The report of the postoperative X-ray examination on May 21, 1927, was as follows: "Definite mottled opacity at the right base and the right diaphragm is indistinct; also, there is some uniform mottled density in the region of the costophrenic angle. Changes suggest an infectious process at the right base with a small amount of fluid. At the present time there is no shadow that suggests a bubble of gas above the diaphragm."

On March 22, 1928, she was re-examined. She had no digestive distress whatever and no trouble with swallowing. Her color was good and her weight 137½ pounds. Examination of the abdomen was negative. She seemed entirely well.

On October 13, 1928, fluoroscopic examination showed the herniation above the diaphragm still present.

The principal complaints in this patient were evidently due to the pyloric obstruction, which, in view of the postoperative course, was secondary to ulcer. I believed that this patient was entirely cured; the finding of a recurrence of the hernia on X-ray examination was a surprise. There were, however, apparently no symptoms referable to the hernia, once the pyloric obstruction had been relieved.

CASE 3. A married woman of 64 years entered April 30, 1928, from the Out Patient Department, where she had applied for treatment of a vaginal discharge. She also complained of abdominal discomfort. In the course of study a gastro-intestinal X-ray was taken which showed a diaphragmatic hernia.

Fifteen years previously her gall bladder had been removed for cholelithiasis. Following this she was free from abdominal symptoms until 2 years ago, when she noticed a dull pain in the left upper quadrant. Immediately after she ate, or on exertion, particularly if she leaned forward, the pain

Fig. 2. Case 2. Following a barium meal.

became sharp and severe, radiating through to the back, and was sometimes accompanied by vomiting of food recently eaten. Associated with this pain there was a cramp-like "knotted" feeling of a mass in the left upper abdomen and sometimes gurgling of gas. This symptom, although disagreeable, was not incapacitating and had apparently not affected her general health. There was no difficulty in swallowing. Loss of weight was questionable. She had some dyspnœa and precordial pain on exertion, with occasional attacks of vertigo. The remainder of her personal and family history was not important.

Examination showed an elderly woman, apparently in good general health. Examination of the chest was negative, except for a systolic murmur, loudest at the heart apex. Her blood pressure was 215–110. She was tender to pressure across the upper abdomen, but no mass could be felt at the site of the "knotted" feeling under the left costal margin. The vaginal discharge was apparently due to a vaginitis.

X-ray examination on May 2, 1927, showed a herniation of the upper half of the stomach through the œsophageal opening of the diaphragm. The upper portion of the stomach lay within the thoracic cavity. The lower portion of the œsophagus appeared to be displaced somewhat to the right. There was slight delay at the junction of the œsophagus and stomach. There was no hour stasis and very slight delay in the upright position. The first portion of the duodenum was normal. The six hour meal had reached the colon.

The diagnosis was hernia of the stomach through the œsophageal opening, a finding which explained

Fig. 3. Case 3. Before operation. Barium filled part of stomach showing above diaphragm.

the left-sided pain and cramp-like sensations. Influenced by the ease of closure in the previous case, operation was advised, although the symptoms were not urgent, and the patient was not a particularly good risk.

Operation was done under ether anæsthesia on May 9, 1927. The patient was slightly hyperextended, with the thorax elevated. Exploration of the abdomen by means of a long incision through the right rectus muscle was negative except for the hernia and for adhesions in the gall-bladder area. The upper part of the stomach had passed through the œsophageal hiatus into the hernial sac. The hernial ring easily admitted four fingers. The stomach was non-adherent and easily delivered. Exposure for suture was difficult. Five interrupted sutures of chromic catgut were placed through the margins of the ring, uniting it transversely. The tissues grasped by these sutures were not satisfactory in firmness.

Following operation, patient's condition was fair. On the fifth day, mild sepsis of the wound developed, and at the same time elevation of respiration to 35 with a temperature close to normal. Dullness appeared at the left base, which was interpreted on physical examination and by X-ray as consolidation. There was cough with a moderate amount of expectoration. On the twenty-sixth day a chest tap was done, 10 cubic centimeters of straw-colored material being obtained, with 70 cells per cubic millimeter. Cultures showed no growth. She gradually improved and was discharged on the forty-sixth day, still with signs at the left base. X-ray examination showed a recurrence of the hernia.

Following discharge she improved very slowly, eventually regaining her weight and strength. During the fall, a bulge developed in the wound, which increased to a large hernia.

When seen on July 9, 1928, she complained of the hernia in the wound which caused discomfort on cough or exertion. She had no indigestion or gastric distress and no difficulty in swallowing. Her complaints were directed to the incisional hernia alone; she no longer mentioned the symptoms existing previous to operation, nor could any hint of a diaphragmatic hernia be obtained on close questioning. Nevertheless X-ray examination showed a recurrence of the hernia.

Operation in this case was unwise. The symptoms did not justify the risks of exploration in a woman of her age and condition. It was particularly unfortunate that wound sepsis and pulmonary complications developed. The pleurisy with effusion was probably associated with lung pathology rather than with trauma to the diaphragm caused by suturing the hernia.

Case 4. A married woman of 62 years was seen in consultation on October 10, 1927, on account of painful attacks occurring during meals. These attacks had come on during the past year although previous to this she may have had some difficulty in swallowing. They were characterized by sudden distress as if she had swallowed too large a mouthful and occurred at irregular intervals, always at table. The last attack occurred during dinner, caused severe pain, and was accompanied by vomiting and retching. Very little of the food eaten returned, but only a frothy substance. Following this attack she was careful to chew thoroughly, and not to swallow too large a mass, and she had no further distress. Her general health was otherwise very good, although she had suffered a good deal from epigastric distress and heartburn with regurgitation, and was habitually constipated. Her weight was increasing.

She had had typhoid as a young woman, two attacks of pleurisy with effusion, and four abdominal operations, one 24 years previously for appendicitis and umbilical hernia, an hysterectomy 11 years previously, and the others for subsequently developing cystic ovaries. The remainder of the history was unessential.

Examination showed a woman apparently in very good health. The chest was negative on auscultation and percussion. No murmur or splashing could be heard on swallowing. The abdomen was negative aside from a slight weakness in

an old scar. The urine was normal. The blood showed a slight secondary anæmia.

X-rays taken previously revealed a diaphragmatic hernia and a gall bladder containing numerous stones. A report of the barium examination of the stomach stated that the meal passed readily down the œsophagus, to the cardia, where there was a slight delay. The stomach filled in the usual manner and showed no irregularity of outline or peristalsis, when patient was in the upright position. With patient in the supine position, a knob-like projection was seen arising from the cardia close to the junction of the stomach and œsophagus. When the patient was rotated the shadow changed somewhat in shape but did not disappear until the prone position was reached. When the barium contents returned to the stomach, the outline of the projection was visible, however. This examination showed definite evidence of a variation from the normal near the cardiac orifice. The findings were thought to be due to a pouching of the stomach through the diaphragm. The deformity was reduced when the patient was upright. A large diverticulum of the lower end of the œsophagus was considered, but the absence of filling in the upright position made this diagnosis very improbable.

In this patient, the principal complaints associated with eating were undoubtedly due to hernia of the stomach through the œsophageal orifice in the diaphragm. At the same time it was possible that the gall stones contributed to the distress and heartburn. Operation was offered on the following basis: the hernia would be explored; if it seemed probable that the stomach might become tightly incarcerated, or some other viscus strangulated, repair would be attempted, provided the margins of the hernial ring were such as to promise a good closure. Failing these conditions, the gall bladder would be removed, if it could be safely accomplished.

An exploratory laparotomy through a right rectus incision was done on October 14, 1927. The peritoneal cavity was found free except for adhesions in the right lower quadrant and adhesions to the umbilicus. The liver was scarred, large, and low, with a thin margin. The gall bladder was tense and full of stones. The stomach and duodenum were negative. At the œsophageal orifice there was a hernial pouch about 8 centimeters in diameter. This communicated with the peritoneal cavity through a large ring. There were no adhesions. In view of the size of the ring, it seemed unlikely that a strangulation would occur. Exposure was extremely difficult and the sutures seemed unlikely to hold and, consequently, no attempt was made to repair the hernia. The gall bladder was removed.

On September 16, 1928 her son, a physician, wrote as follows: "Since operation she has been practically relieved of her heartburn. She has had practically no trouble from the gaseous eructations and the distress which used to bother her. She has had two rather mild attacks like the ones she had before operation, characterized by sudden inability to swallow during meals. These were precipitated by too rapid eating of dry foods. By avoiding dry foods and by very slow eating she can practically avoid recurrence of her trouble. Her general health appears excellent."

Fig. 4. Case 4.

While the diaphragmatic hernia is unrelieved in this case, the patient gets on quite comfortably by attention to details of eating. Removal of the gall bladder apparently led to definite benefit, possibly through improvement in gastric motility. In view of the operative findings, any sudden accident due to the hernia is extremely unlikely.

Case 5. A woman of 51 years entered the hospital January 31, 1928, complaining of increasing weakness of one year's duration, which finally forced her to give up her usual housework. This weakness was accompanied by dyspnœa on exertion and by palpitation. She had no definite digestive symptoms, her appetite was fair, and she had no nausea or vomiting. She suffered from habitual constipation and for many years had had at times a sensation of gas in the stomach, particularly after a full meal or on bending foward. She had no gross blood from the bowel and no flowing since the menopause 2 years previously. There was a questionable loss of weight. The remainder of her history was not important.

Study of her case by Dr. A. V. Bock, previous to admission, showed a definite secondary anæmia

(hæmogrobin 50 to 55 per cent, red cell count 3,800,000) which accounted for her symptoms. Examination of the stools showed repeatedly a positive guaiac test but no gross blood. However, X-ray examination of the gastro-intestinal tract was negative, including that of the colon by means of a barium enema. The cardiac portion of the stomach projected upward above the level of the diaphragm. This herniation occurred approximately in the median line. The diagnosis was diaphragmatic hernia with no evidence of malignancy of the gastro-intestinal tract.

Physical examination showed a woman somewhat overweight in apparently good condition aside from a moderate anæmia. Otherwise the only important positive finding was rumbling sounds as of gas in a viscus heard over the chest posteriorly, particularly on inspiration. Rectal examination was negative except for a small fissure. Proctoscopy revealed a normal rectosigmoid mucosa, without evidence of bleeding from higher up.

The important feature of this case was the anæmia which was incapacitating her and appeared to be due to hæmorrhage into the intestinal tract above the rectosigmoid region. Since malignancy could not be completely excluded in spite of the negative X-rays, operation was advised and accepted.

On February 3, 1928 exploration of the abdomen was entirely negative aside from the diaphragmatic hernia. At the œsophageal orifice there was an opening 6 centimeters across, oval transversely, through which the anterior part of the fundus of the stomach had prolapsed. The stomach was readily delivered. No attempt was made to close the ring, which would have been difficult on account of its shape and the tension of the diaphragm. Since there was no obvious source of hæmorrhage and no new-growth within the peritoneal cavity, the wound was closed after removal of the appendix. The sphincter ani was dilated.

Following operation she made a good convalescence. However, a positive guaiac test for blood appeared in the stool previous to discharge on February 20, 1928.

This patient was seen again in December, 1928. While superficially she appeared well and had maintained her weight, she had been an invalid, with the exception of 2 or 3 weeks in September, on account of anæmia, with symptoms of dizziness, weakness, dyspnœa, and palpitation. The only evidence suggestive of hernia was in the stomach. The operative wound was well healed. Dr. Bock found a hæmoglobin of 55 per cent, a red cell count of 3,000,000, and a strongly positive guaiac test present in the stools on two successive days. Proctoscopic examination by Dr. C. M. Jones was negative.

This patient suffered very little as a direct result of the presence of the hernia, and from this aspect repair was not essential. The important point is whether her gastro-intestinal hæmorrhage and her consequent anæmia were due to congestion of part of the stomach from constriction in the hernial sac. All that can be said is that no other cause of loss of blood has appeared during the 10 months since operation. On account of her disability, further operation is under consideration.

These patients were all women over 50 years of age, a fact suggesting an acquired condition and agreeing with Morrison's (5) statement that the condition is commoner in women. The symptoms are confused because of the associated pathology. Those that seem clearly due to the hernia were, in Case 3, dull pain in the left upper quadrant with radiation to the back, associated with a cramp-like feeling, and, in Case 4, attacks of difficulty in swallowing at meals with distress high in the epigastrium, occasionally with associated retching and vomiting. In Case 1, knowing the diagnosis, it is now possible to correlate mild symptoms with the hernia. These are regurgitation of a little gas and food after eating and a spasm of distress felt just above the ensiform, if dry or coarse foods are taken in a hurry. In Case 5, a persistent ooze of blood from the gastro-intestinal tract is best explained on the basis of diaphragmatic hernia.

Healy states that the symptoms of this type of hernia present the widest variations. Large herniæ may be present at times without symptoms. Most of the patients complain of a vague discomfort or pain radiating to the back and often to the left shoulder. They may have regurgitation in the morning with hyperacidity, if they have been sleeping on their backs. A few have difficulty in swallowing solid food at times. Morrison (5) mentions pain or distress just above or anterior to the ensiform cartilage, not epigastric, as the most constant symptom. There may be a lump under the sternum. The distress is frequently at night. Hæmatemesis may occur.

The history, therefore, is not distinctive. It has features in common with peptic ulcer. The character and variability of the pain is somewhat suggestive of mild attacks of cholecystitis. Undoubtedly these are the

diagnoses usually made. The danger, therefore, is that the actual cause of the symptoms, the hernia, may be entirely overlooked, even at operation. Consequently other operations are likely to be undertaken without the true diagnosis becoming established. Since the significance of slight variations from normal in its pathology and function have been so much stressed, the gall bladder would seem particularly likely to be removed.

Morrison (6) has followed some of his cases from 3 to 6 years and is firmly of the opinion that relatively few need operation. If these patients believe that the condition is not serious and understand how to take care of themselves, they can tolerate their symptoms. This opinion is borne out by the clinical course of Cases 1 and 4. It seems probable that the symptoms are increased by factors tending to increase stasis in the stomach, such as organic obstruction of the pylorus, or spasm associated with ulcer or cholecystitis. Benefit may be obtained by relief of such conditions, although the hernia itself persists.

In regard to operative treatment, the two attempts at suture were both failures, although this could not be demonstrated without postoperative X-ray examination. This check would seem to be extremely desirable before a case is reported cured. An unsuccessful attempt at repair might even increase the symptoms, either by constricting the hernial ring or by causing the stomach to become adherent within the hernial sac. Suture is rendered difficult by the width of the ring and by the presence of the œsophagus, which, like the spermatic cord, prevents complete closure. The condition would rarely seem to be serious enough to justify producing a unilateral paralysis of the diaphragm through section of the phrenic nerve to facilitate closure. These factors should all receive due consideration before operation is attempted directly upon the hernia.

The œsophageal hiatus is relatively accessible through the abdomen and less easy of approach than other parts of the diaphragm through the thorax. The occasional existence of other intra-abdominal pathological conditions would seem to make the abdominal route more desirable. Closure of the ring without dealing in any way with the ring margins or sac by means of interrupted chromic gut sutures did not hold in these cases. In future cases if closure of the hernia seems desirable, I should be inclined to attempt fascial repair.

The purpose of this paper is not to discuss operative technique, but to call attention to the possibility of overlooking herniæ through the œsophageal orifice of the diaphragm and to certain characteristics of this condition. It would seem to be a condition causing little danger to the individual, so that operation is not imperative. On this account, its treatment may well be considered independently from that of other types of diaphragmatic hernia in which the danger of intestinal obstruction is considerable. Since this form of hernia may cause a group of symptoms somewhat resembling those of other upper abdominal conditions, it has definite importance in differential diagnosis and should be sought for in abdominal exploration. Discussion of diaphragmatic hernia would be clarified, with respect to diagnosis, prognosis, and treatment, if hernia through the œsophageal orifice were separated as a clinical entity, apart from the general group.

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ENDOMETRIOSIS IN UTERINE CORNUA

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GLAND-LIKE structures lined with columnar epithelium have been described frequently as occurring in the uterine and tubal wall in various locations, especially in the region of the interstitial or uterine portion of the fallopian tube associated with nodular enlargements of the cornua of the uterus.

Sampson has reported, recently, histological studies of the tubal stumps of a series of cases which had undergone salpingectomy or tubal sterilization at a previous operation and demonstrates multiform adenomata with varying resemblance to uterine or tubal mucosa. These are described as "histologically typical uterine or tubal mucosa apparently arising from the traumatized and activated mucosa of the tubal stump." Similar lesions, adjacent but not immediately in contact, he interprets as "seedlings" planted either as uterine mucosa washed from the tubal stump at the time of salpingectomy or as a differentiation of traumatized tubal mucosa in the form of sprouts. These lesions, therefore, are grouped as "post-salpingectomy" endometroses. These lesions first came to my notice in the Pathological Laboratory of the Lakeside Hospital several years ago as a somewhat frequently associated lesion in cases of salpingitis isthmica nodosa, in histological sections through the enlarged cornual portions of the excised tubes. Hence, there can be little doubt that these adenomata, in our cases at least, certainly existed prior to the salpingectomy and that they have not been transplanted or implanted subsequent to operation. If they are related to or derived from mature endometrium or tubal mucosa, it appears that they may have occurred rather by direct invasion of tubal or uterine mucosa under some stimulus or from a common ancestral cell rest which assumes a tardy growth activity.

Therefore, the study was undertaken of a small series of cases of the nodular type of salpingitis, noted on pathological examination at the time of operation to have gland-like spaces situated principally in the uterine cornua. The morphology of these pseudo-uterine glands, as compared with that of the curettings obtained from the uterus at the time of operation, the presence or absence of physiological response to menstruation in the cornual gland-spaces, and the extent of the associated inflammatory disease of the tubes, were noted.

Chiari, in 1887, described nodular enlargements of the fallopian tube as occurring in a small percentage of a large series of autopsy specimens. He explained these enlargements as the result of hypertrophy or hyperplasia of the wall of the tube, and the small cyst-like structures lined with columnar epithelium, which are noticed scattered through the stroma, he accounted for as protrusions of the tubal mucosa cut off from the lumen of the tube under the influence of inflammation (Ries). The epithelial elements, i.e., gland-like structures, hence, are associated with both hypertrophic and hyperplastic changes in connective tissue. Epithelium-lined cysts in the uterine cornua, found in connection with chronic inflammatory disease of the tube, have been regarded often as stigmata of gonorrhœa. Schauta originated the term most frequently applied to this lesion, i.e., interstitial salpingitis or salpingitis isthmica nodosa.

Frank, quoting Rabinowitz-Robinson, states that the tubal lesion is due, on the other hand, to tuberculosis in fully 25 per cent of cases of nodular enlargements which are near the cornual portion of the tube. This is so markedly in excess of the normal 5 to 6 per cent incidence of tuberculous salpingitis that it is striking. Consideration of these gland-like structures, occurring principally in association with inflammatory tubal disease, which have varying resemblance to uterine glands, suggests that a study of these structures may cast additional light on the problem of endometriosis.

After careful study of the pathology of various types of inflammatory fallopian tubes,

Curtis agrees with Ries that gland-like epithelial spaces lined with columnar epithelium are initiated by inflammation. Such epithelial cysts are probably not always present with nodular inflammatory disease of the tubes, as in our series where multiple routine sections showed gland spaces in 50 per cent of a small series of "salpingitis isthmica nodosa" (not sectioned serially). Curtis has described gonococcal abscesses in typical nodular tubal enlargements of salpingitis isthmica nodosa, and (Schauta) invasion of such abscesses by epithelium has been proposed as the source of these epithelialized glandular spaces, i.e., invasion of an abscess cavity communicating with the cells of the lumen or peritoneal surface, which subsequently are nipped off by connective tissue elements, producing these apparently isolated glands (Fig. 2).

Many hypotheses have been advanced to explain the etiology of pelvic tumors of gland-like tissue resembling endometrial glands. Von Recklinghausen explains these lesions as wolffian rests. The diffuse distribution of adenomatous nodules in the pelvis, utero-sacral ligament, and rectovaginal septum, etc., composed of gland-like structures with varying round-cell stroma and dense connective tissue, as well as histological and biological correspondence of some of these lesions both as to glands and stroma, with uterine mucosa, has been emphasized by Cullen.

Wolffian origin and derivation from mesonephric rests have been variously suggested (Pfannenstiel, Pick, Babo). Others have suggested parent muellerian tissue as the source. Robert Meyer also has presented evidence in favor of the idea that under the stimulus of inflammation, cystic structures may come into being, the growth extending from the surface of the epithelial lining of the tube into small abscesses in the tubal wall. Metaplasia and the ingrowth of the peritoneal mesothelium, presumably as the result of inflammation, has been noted (Ivanoff).

Sampson concludes from his studies that endometrial lesions occur frequently by direct implantation of fragments of mature endometrium or tubal mucosa, either by transplantation directly, which apparently occurs in abdominal scar endometrioma, or by regurgitation of the menstrual blood occurring through the fimbria of the tubes causing either primary implantation of the pelvis or secondary implantation after the process of "incubation" in the ovaries. The ovary, he believes, serves as intermediate host, and that hæmorrhagic cysts may often rupture, discharging their content, the cells of which are reimplanted to form additional metastases.

Most recently, Novak has pointed out the probability of ancestral cœlomic mesothelial cell as the most probable etiological factor capable of undergoing evolution forming ectopic uterine endometrium. He believes the primitive cœlomic mesothelium is concerned, in many instances at least, in the histogenesis of endometriomata and doubts the occurrence of menstrual flow through the fallopian tube with any frequency. This is in accord with our experience in a clinic where, though laparotomy is performed on menstruating women very frequently and where laparotomy is always preceded by a routine curettage, nevertheless, we see blood exuding from the tubes with extreme rarity.

In accordance then with the theory of tubal dissemination of epithelial fragments, it was recently suggested by Sampson that the endometrium-like gland spaces found in the cornua of the uterus following previous salpingectomy were due to direct implantation of endometrial or tubal cells into the cut surface of the uterine wall at the cornu. This, he assumes, occurs at the time of the removal of the tubes, and these cells then take root in the uterine cornua as implantation endometriomata. Certainly, these glands and stroma in appearance are often similar to typical uterine glands. Acceptance of this origin is, however, not consistent with the common experience of finding such adenomatous spaces at the time of removal of the tubes, particularly in the cases of nodular salpingitis or salpingitis isthmica nodosa. It is suggested by our observations on the following cases that the lesions found in the cornua at autopsy or operation, long after salpingectomy, were in existence at the time of salpingectomy.

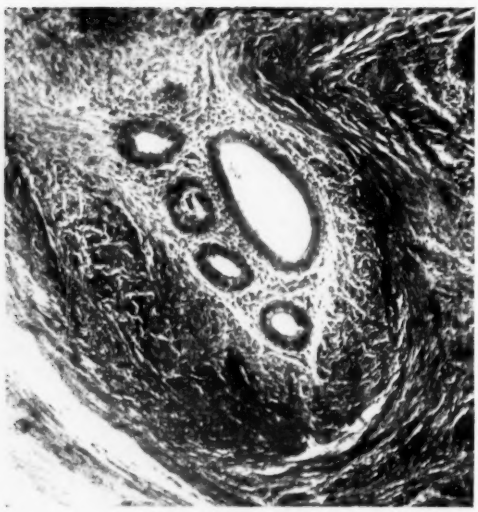

Fig. 1. Case 1. No. 14300. Section shows gland spaces of various sizes in round cell stroma suggesting endometrium. They are lined with medium high columnar epithelium and resemble very closely typical uterine glands. ×67.

Case 1. C. L., colored, aged 27 years, i-para. No. 14300. The patient entered the hospital complaining of pain in the lower abdomen, profuse leucorrhœa, and moderate dysuria. The anamnesis was of no importance except that some 6 weeks before, a curettage had been performed for dysmenorrhœa, at which time no inflammatory masses were palpated. On pelvic examination at this admission, the outlet and cervix were in good condition, the uterus small and in midposition. There was bilateral thickening of the adnexa. At operation, the uterus was in midposition, and the sigmoid adherent in one place. Both tubes were enlarged, especially at the proximal end. There were bilateral nodules at the cornua of the uterus, the left being larger than the right. Supracervical hysterectomy was performed.

Pathological diagnosis. The tubes were thickened, covered with adhesions, moderately adherent, and the fimbriated ends closed off. The cornual portion of the tubes was enlarged and merged into the bilateral cornual tumors of the uterus.

Histological examination. The cross section of the tube shows an intact high columnar epithelium lining the tubal lumen. There is complete absence of any infiltration about the lumen of the tube. The connective-tissue elements are moderately hypertrophic and hyperplastic. Scattered at various intervals in this myofibrotic stroma, are gland-like structures lined with cells with large even nuclei, the glands resembling uterine glands perfectly. There is a well-marked stroma surrounding this group of glands (Fig. 1). The cells of the stroma resemble quite closely the typical cells of uterine stroma. In general, they are, however, slightly more elongated. There is no evidence of menstrual reaction although there are a few red cells in the lumina. There is no marked evidence of inflammation. Uterine curettings, in this case, showed very small glands uniformly distributed. The diagnosis was early resting endometrium. The nuclei of the lining of the cells of the tubal lumen occupy relatively less of the cell body than do the nuclei of these ectopic and endometrial gland cells. There is in the tubes a low grade of chronic inflammatory disease. However, it is impossible to say whether salpingitis is an incidental accompaniment of these adenomata or that the growth of these glands was due to the stimulus of inflammation.

Figure 1 shows several gland spaces lined with medium height columnar epithelium, containing a few red blood cells. There is a development of typical round cell stroma suggesting endometrium.

The section from another block (Fig. 2) shows an organizing chronic abscess composed of a fibrinous reticulum in which there are entangled many plasma cells and polymorphonuclear leucocytes. In the wall can be seen a well-marked epithelial border suggesting that epithelial cells may possibly be growing into an abscess cavity.

Case 2. M. L., colored, aged 32 years, ii-para. No. 14272. The patient was admitted to the hospital complaining of pain in the lower quadrants, accentuated on the right side. She had fever and malaise of 2 weeks' duration. Past history was negative. Five years previous, the patient had symptoms of frequency and burning on urination. She had pain in the right side and was confined to bed for a few days, recovering from her symptoms entirely at the end of a month. Three weeks later she was in bed for about a month with fever and abdominal pain.

Her menstrual history was negative. Laboratory findings revealed nothing except a mild leucocytosis. At pelvic examination, there were small bilateral masses apparently adherent to the uterus. Laparotomy was performed. The tubes were found thickened, adherent, and enlarged close to the cornua of the uterus.

Pathological diagnosis. The tubes were twisted and covered with adhesions, the walls were thickened, and the fimbriated ends were closed. Thickening of the wall was marked in the region of the uterine cornua where the stroma is extremely cellular.

Diagnosis. Salpingitis isthmica nodosa. Cornual cysts. The uterine curettings showed a variance in type of glands ranging from small uniform glands of the zona compacta to glands of rather more complicated shapes in the deeper layers. There is some evidence of early premenstrual swelling, the deeper layer glands showing papillary ingrowths. In other places there is a marked increase in the density of the stroma.

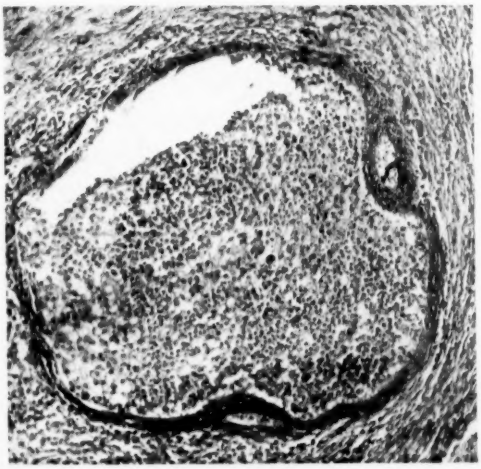

Fig. 2. Case 1. No. 14300. The section from another block shows in one portion of the field, an organizing chronic abscess composed of plasma cells, round cells, and polymorphonuclear neutrophiles. In the wall can be seen an epithelial border. This suggests rather that the epithelium invades and lines an abscess cavity rather than that this is an abscess in and about an adenoma. The single layer of epithelium contains very large nuclei which are undergoing active mitosis. ×67.

Fig. 3. Case 2. No. 14272. Section shows cornual portion of the tube, the epithelium of which is well preserved and unimpaired. Adjacent are several large epithelium-lined spaces, the appearance of which differs from that of the epithelium lining the tube. The integrity of the tubal lumen seems unimpaired, as it is entirely symmetrical. These gland-like spaces were in existence at the time of salpingectomy. The lumen of the tube in the region of the cornua shows the almost complete absence of infiltration in the endosalpinx. Typical of the inflammatory process found in tubes of salpingitis isthmica nodosa is the relatively slight inflammation of endosalpinx and peripheral ends of the tubes. ×80.

Figure 3 is a section through the cornual portion of the tube showing the lumen with typical plicæ. There are several large epithelium-lined spaces with no endometrial stroma. There is moderate infiltration of the plicæ, but the surface epithelium, which is high columnar and ciliated, is intact. The epithelium in the adjacent gland spaces is quite evidently a different type, the cells being smaller and the nuclei largely filling them. There is slight evidence of any inflammatory reaction in the epithelium lining the tube.

Case 3. C. R., aged 29 years, i-para. No. 14404. The patient entered the hospital complaining of pain in the right side of 2 years' duration. Pelvic examination revealed a marital vaginal outlet and a normal cervix. The uterus was small, retroverted and adherent, and there were palpable bilateral masses. At operation, the uterus was found to be held posterior by many adhesions. The tubes were enlarged and adherent to the pelvic floor and to the uterus. The tubes were sclerosed and covered with adhesions and the fimbriæ were closed. The walls were definitely thickened. The microscopic picture showed relatively slight evidence of any marked infection. The walls were slightly thickened and infiltrated with a few lymphocytes. There was slight desquamation of the mucosa of the tubal lumen. In the mucosa were gland spaces isolated from the tube, lined by single low columnar epithelium. These were not surrounded by round cell infiltration. Uterine curettings showed glands of uniform size, small, with no variation or tufts. The glands were perfectly round. There were no areas of blood in the interglandular stroma.

Figure 4 is a cross section of the tubal lumen with adenomatous structures intervening and a section of the uterine endometrium. In the corner of the section was a small portion of what were apparently typical uterine glands with a relatively small amount of intervening stroma. These glands were undergoing a reaction of hyperplasia with subepithelial infiltration of blood. (The curettings were in the resting state.) There was no evidence of a similar reaction in the adenomatous spaces. The cells lining the tubal lumen, however, showed some desquamation. The cells lining the lumen of the adenomata, however, were perfectly intact. The morphological differences between the epithelial cells of the adenoma and of the uterine glands were particularly marked in this section, the cells of the uterine glands

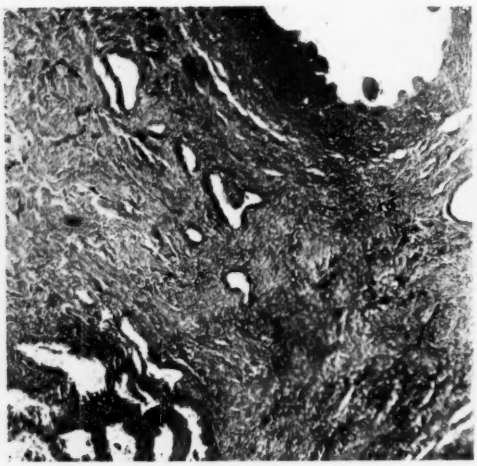

Fig. 4. Case 3. No. 14404. The section shows a cross section of the same tubal lumen with adenomatous stroma intervening in the section of uterine endometrium. There is some evidence of premenstrual hyperplasia in the uterine glands. Cells of the uterine glands are markedly different from the cells of the interstitial adenomata. The epithelium of the adenomata resembles more closely the cells lining the lumen of the tube. ×55.

being markedly high columnar with nuclei situated in the bases and with desquamation going on; whereas many of the adenomata were composed of low columnar epithelium with not the slightest suggestion of response to menstrual reaction and differing entirely in appearance from the adjacent uterine glands as well as from the larger tubal cells the intracellular area of which was almost entirely occupied by their nuclei.

Case 4. No. 12496, colored, aged 22, i-para. This patient came to the hospital complaining of pain in the right lower abdomen. The urine was negative. White blood cell count was 11,200. The outlet was marital, the cervix was in good condition, and the uterus was anterior and slightly fixed. A low midline incision was made. On inspection of the pelvis, there was found bilateral thickening of the isthmic portion of the tubes. The pathological diagnosis was typical salpingitis isthmica nodosa. Microscopically, the tubal mucosa was in good condition, there being practically no desquamation. There was apparently slight round cell infiltration of the plicæ. The tubal epithelium was medium high columnar.

Scattered through the stroma were numerous gland-like spaces composed of a very low cuboidal epithelium not suggestive of tubal wall. There is no suggestion of reaction to menstruation. Uterine curettings showed a great increase in the glandular elements, the glands being tortuous, with papulary swellings in the mucosa lining. There was the

Fig. 5. Case 4. No. 12496. Here are several glands of the uterine type. It is a round and spindle cell stroma, the cells of which may be seen to blend into the typical connective tissue cells of the interglandular stroma. The adenomata, however, have a typical "endometrial" appearance, but there is no reaction comparable to the endometrium which in this case was in late premenstrual phase. ×67.

typical cork-screw appearance of premenstrual swelling. There was complete absence of inflammatory reaction in the tissue.

Figure 5 shows several glands of "uterine type." There is a round and spindle cell stroma, the cells of which are apparently modified connective tissue cells and merge into the typical elongated connective tissue cells by definitely perceptible degrees. The glands, however, are definitely endometrial in appearance.

Figure 6 shows gland spaces of the larger size with very low cuboidal epithelium, differing entirely from the typical "furry" lining of the tube. The epithelium is not flattened by the distention, for there is no bleeding and no attempt at a menstrual response.

There is a rather marked inflammatory infiltration of the stroma of the tubal wall (Fig. 7). The lumen of the tube has disappeared and is replaced by an infiltration of round cells and polymorphonuclear cells forming chronic abscesses so that it is impossible to discover exactly where the lumen of the tube was originally. This section suggests that such inflammatory processes may be the means by which epithelium is nipped off from the tubal lumen, or possibly, from the other point of view, mesothelial cells of the peritoneum may penetrate from the surface.

Case 5. A. A. G., aged 33 years, ii-para. No. 12956. The patient came to the hospital complain-

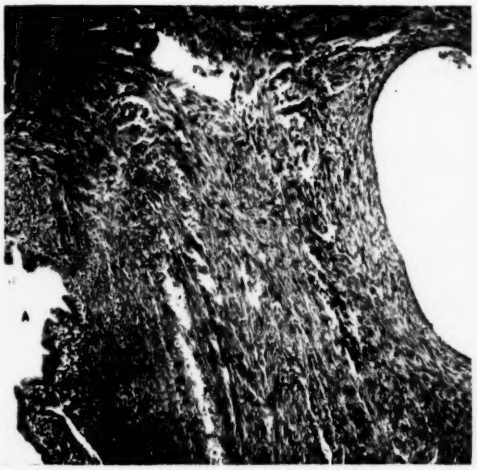

Fig. 6. Case 4. No. 12496. Section shows a gland space lined with very low cuboidal epithelium, in appearance differing entirely from the lining cells of the tube, *A*. The epithelium was not flattened by distention for there was no attempt at the menstrual response. ×55.

Fig. 7. Case 4. No. 12496. The section shows a marked inflammatory infiltration of the stroma, the lumen of the tube having disappeared and is replaced by a chronic abscess composed of round cells and polymorphonuclear leucocytes. ×55.

ing of dysmenorrhœa and frequency on urination. The outlet was marital, the cervix was eroded, small and lacerated, and the uterus was enlarged and anteflexed. There was thickening and a tender mass, the outlines of which were made out with difficulty on the right side. At operation, there were found numerous adhesions. There had been a previous salpingectomy and there was a nodule at the uterine cornu on the right side. This was excised. Histologically, the sections showed a rather dense fibrous connective tissue, large cystic spaces without evidence of stroma lined by a very low cuboidal epithelium. There is little evidence of inflammatory reaction here. Uterine curettings show typical resting endometrium. This is a case which might be assumed, reasoning *post hoc propter hoc*, to be an example of postsalpingectomy endometriosis, for a salpingectomy preceded the recovery of the cornual nodule by several years. However, in the light of the four preceding cases, I am inclined to assume that the lesion antedated the salpingectomy.

Twelve cases of salpingitis isthmica nodosa were studied and cornual adenomata were found in five which gives one the impression that there may be a relationship between inflammatory disease of the tube and cornual "endometriomata." This is in marked contrast to the fact pointed out by Sampson that endometrium-like lesions outside of the uterus are almost invariably associated with patent tubes, i.e., absence of severe tubal disease. It is well known that an inflammatory process can produce a hyperplasia of epithelium and a marked increase in its rate of growth. In favor of the tubal or peritoneal theory of origin of these lesions is the fact that these lesions seem to show a response to the menstrual stimulus at least to the extent of actual gross bleeding. Novak has recently shown clearly that cyclic changes characteristic of menstruation occur in tubal epithelium but without any bleeding.

The amount of characteristic stroma surrounding the glands is also capable of a great variation. The photomicrographs show every grade of transition clearly from the typical stromal cell of uterine type to the elongated cells of fibrous connective tissue, which suggests that the ordinary connective tissue cell become modified *in situ* to form the stromal cell which surrounds these glands. Frequently, in cornual adenomata as well as other endometrium-like adenomatous lesions, there is absence of stroma suggesting true endometrium.

Examination of sections through the cornua of uteri removed for prolapse, chronic subinvolution, etc., or of sections through the uterine end of tubes removed with a cornual wedge for ordinary types of salpingitis, reveals no such adenomatous structures as occur with the inflammatory lesion known as salpingitis isthmica nodosa.

SUMMARY

We find in certain cases, at least, of salpingitis isthmica nodosa, the occurrence of cornual adenomata with a greater or lesser resemblance to uterine or tubal epithelium and with a varying amount of surrounding stroma which suggests, in appearance, that of the uterus.

These lesions apparently do not react always with characteristic changes to the menstrual cycle which suggests the condition of hyperplasia of the endometrium (Fig. 1). The severity of the infection is probably not an important factor, for the fimbriated ends of the tubes are frequently patent although the cornua may contain many adenomatous lesions and the lumen of the tubes may be completely replaced by hypertrophic and hyperplastic connective tissue and leucocytes.

It is possible that these lesions may occur as sprouts from traumatized tubal or uterine mucosa after salpingectomy, but they existed in these cases (1, 2, 3, and 4) certainly at the time of salpingectomy.

CONCLUSIONS

1. Adenomatous lesions of the uterine cornu occur frequently in association with the form of inflammatory disease of the tube known as salpingitis isthmica nodosa and may be demonstrated *at the time* of salpingectomy. It seems unlikely that they arise commonly after salpingectomy from implantation or outgrowth of traumatized tubal or uterine mucosa.

2. While infection may be an etiological factor in the production of cornual adenomata, the severity of the associated inflammatory process is variable.

3. Adenomatous structures, except for parovarian tubules, are seen infrequently in normal uterine cornua.

4. The morphology of cornual adenomata varies widely, and response to the menstrual stimulus in the form of bleeding is uncommon.

I wish to acknowledge with thanks the assistance and co-operation of Dr. Ward W. Summerville and Dr. Allan Moritz of the Department of Pathology, Western Reserve University. I wish also to thank Professor Elliott C. Cutler of the Department of Surgery for his helpful criticism. The drawing is by Miss Theodora Bergsland, the artist of the Department of Surgery, and the photomicrographs by Benjamin W. Brownlow.

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THE MORPHOLOGY OF NORMAL MENSTRUAL BLOOD AND ITS DIAGNOSTIC VALUE

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VON DER LEYEN, Lindner, Sekiba, and others have studied the tissue extruded during the menstrual periods and all have found that in the early days of the menses, mucosa is passed with the menstrual discharge. Rotter investigated the morphology of the menstrual blood, paying particular attention to the hæmatology. He believed that he was able to demonstrate the diagnostic value of differential white cell counts and concluded that the findings in the genital blood might be of assistance in diagnosing carcinoma and in recognizing the interval bleeding due to inflammatory disease.

This investigation was undertaken to determine whether the morphological findings could be utilized to differentiate normal menstrual blood from other bloody vaginal discharges. One hundred specimens have been examined, some few in a complete series from the first to the last day of menstruation; others on 1, 2, or 3 successive days, and of others only one or two samples have been taken.

To obtain the material, a glass tube was placed in the vagina, just within the introitus, and was fastened in place with adhesive tape. The women were kept in bed during the entire period, if necessary. The blood collected was divided into two parts—the one fixed while fresh in acetic acid, 36 per cent, the other in 50 per cent alcohol. In some instances 10 to 20 cubic centimeters were obtained in a few hours; in others only 1 cubic centimeter, which we found in most instances ample for our purpose. The material was centrifuged when necessary, fixed, embedded in paraffin, cut, and stained. Hæmatoxylon-eosin, Van Gieson and occasionally other special stains were used.

The constituents that were particularly studied were the vaginal and uterine epithelium and leucocytes, both mononuclear and polynuclear. The uterine epithelium was found in most marked profusion on the second day of the period, on which day it occurred in 74 per cent of the cases. On the first day it occurred in only 50 per cent; on the third day, in 54 per cent. On subsequent days with a few exceptions, it was not found. It occurred as small strips of columnar epithelium, at times consisting of only a few cells, well stained and as far as the histological appearance could determine, viable (Figs. 1 and 2). At other times the epithelium occurred in long strands with many cells; some well stained, others showing degenerative changes. It occurred also as small clumps of glands, while in some instances, only one tiny gland (Fig. 5) was found. In other specimens the epithelial tissue appeared as large fragments, with tortuous glands and surrounding stroma, while in several instances large masses, similar to the tissue expelled in membranous dysmenorrhœa, were found (Fig. 3). In this latter type no history of unusual pain was elicited. It would seem that with the first appearance of the menstrual flow, uterine desquamation has already taken place, that it becomes more marked on the second day, diminishes on the third day, and ceases on the fourth. This seems to be the sequence in the usual 4 to 5 day type.

We also found clumps of stroma cells which occurred entirely independent of the epithelium and in varying profusion. They may occur as small groups of darkly stained cells, oval, round, or polygonal, varying from 5 to 20 cells (Fig. 4). The nuclei appeared normal, well stained, though at times they showed pyknosis or other evidence of degenerative change. However, the stroma did not show the same extent of necrosis as the epithelium, though in both cases the viable tissue (that is, viable as judged by the histological appearance) far exceeds the degenerative tissue in amount. The stroma extrusion too shows variations, being more common on the second and third days, on which days 90 to 91 per cent of the specimens contained stroma free from epithelium in varying amounts.

Fig. 1. No. 35470. Strip of surface mucosa with small amount of underlying stroma and one small clump of stroma cells sufficient for diagnosis of menstrual blood. ×150.

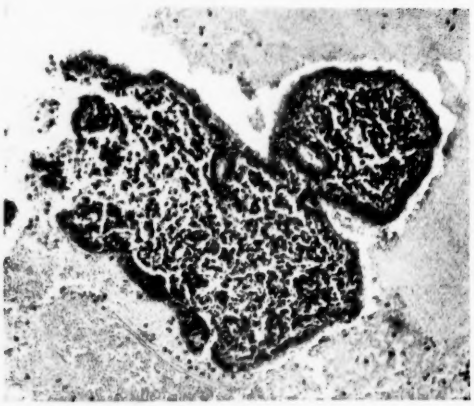


Fig. 2. No. 34635. Large fragment of mucosa showing surface epithelium and a few glands, marked pyknosis of nuclei. Sufficient for diagnosis of menstrual blood. ×125.

On the first day 75 per cent of the specimens contained stroma, while on the fourth day 50 per cent of the cases were still discharging stromal fragments. The presence of these fragments is extremely characteristic and constant and though in some instances only one or two tiny clumps may be found, yet they are sufficiently characteristic to warrant the diagnosis of menstrual blood. A large group of control cases will be reported at a later time. It need only be stated here that in 100 control cases the above features, characteristic of menstrual blood, were not present.

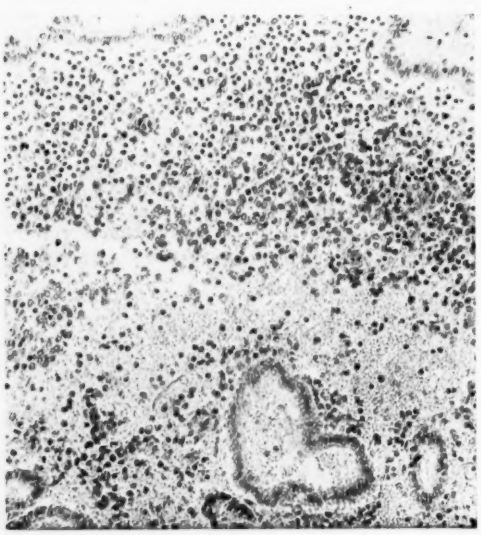


Fig. 3. No. 35211. Large plaque of mucosa showing some well preserved epithelium both on surface and in the glands. Decidual reaction in the stroma. Resembles tissue expelled in membranous dysmenorrhœa. ×120.

We see a slight difference between the desquamation of the stroma and that of the epithelium. The stroma appears as does the epithelium, on the first day, increases progressively up to the third day, maintains a maximum desquamation for 2 days, then diminishes on the fourth and fifth days. It is evident that the amount of desquamation varies in each individual case and may also vary at each period. This variability may account for the divergent views offered by many authors as to the nature and extent of the mucosal destruction.

It is true that in a certain proportion of the cases (9 per cent) either uterine epithelium or stroma or both were missing. This, of course, might be due to the fact that not enough material was examined or that in certain individuals desquamation does not take place.

Corner[1] has described in monkeys a periodic fundal bleeding not associated with ovulation and not accompanied by the usual mucosal hypertrophy. It is possible that the absence of the mucosa in this small group of human

[1]Contributions to Embryology, No. 75, Publication No. 332, Carnegie Institute of Washington.

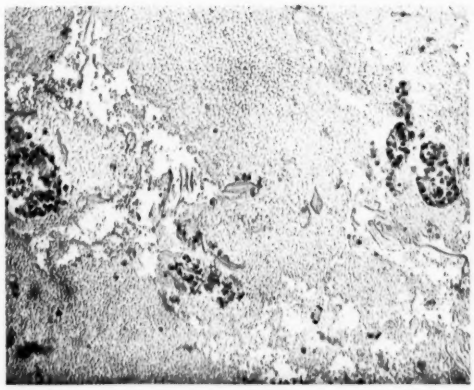


Fig. 4. No. 34835. Small stroma clumps of well preserved cells, sufficient, however, to make diagnosis of menstrual blood. Vaginal spindle cells shown. ×75.

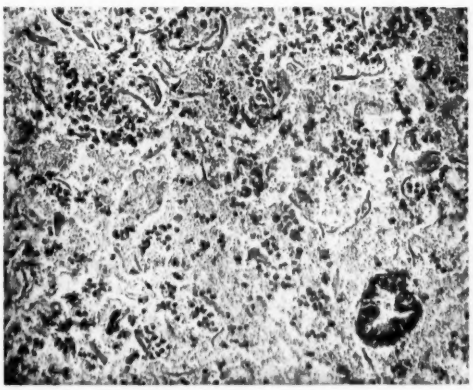
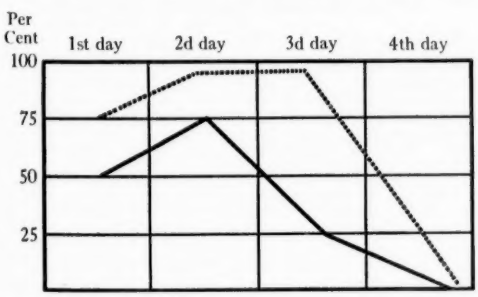


Fig. 5. No. 33517. Masses of isolated spindle cells of varying types, boat shaped, large and compressed spindle cells. One small uterine gland is shown. ×75.

cases may be explained on a similar basis, namely, that in certain individuals menstruation takes place without mucosal desquamation, if not at every period, possibly at some of the otherwise normal cyclical hæmorrhages (Graph A).

Another striking finding was the presence of desquamated vaginal epithelium. It was difficult to establish a definite rhythm as it appeared in practically every specimen of menstrual blood. We designated the epithelium as vaginal spindles if it appeared as isolated cells and as vaginal plaques when it occurred in sheets. In the first group, the cells occurred singly as either short flat spindles containing a small round central nuclei, pale staining with a few taking a more intense stain, or as elongated spindles with very faint staining, round or elongated nucleus or with no nucleus. These latter appeared as cell shadows (Fig. 5). This fat spindle had been described by Papanicolaou[1] in the vaginal specimens from pregnant women. Often about them were clumps of bacteria. The vaginal spindles occurred in 95 per cent of the cases on the first and second day; in 82 per cent of the cases on the third day; and in 100 per cent of the cases on the fourth day. The individual number of cells varied—in some the spindles were numerous, occasionally

[1] Proc. Soc Exper. Biol. & Med., 1924, xxii, 436.



Graph A. Variation in occurrence of uterine mucosa in the menstrual blood. Dotted line represents stroma; solid line, epithelial elements.

Fig. 6. No. 27A. Large fragment of vaginal mucosa showing vacuolization; small well preserved cells. Such large fragments as these are not common. ×120.

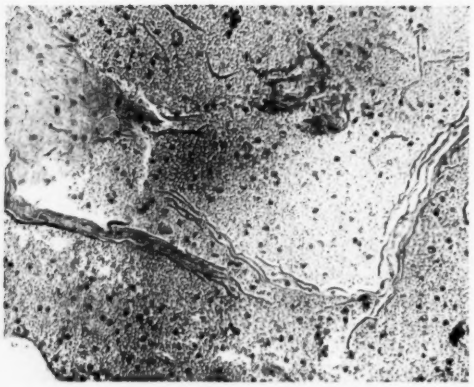


Fig. 7. No. 35211. Strips of cornified vaginal mucosa; one showing at its extremity a flat plaque of epithelium cut tangentially. ×130.

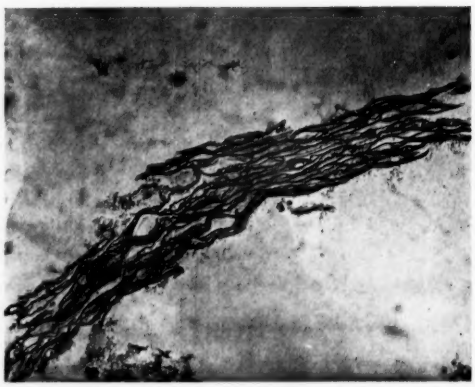


Fig. 8. No. 33333. Large plaque of cornified epithelium. The origin of the vaginal spindles is from these plaques. ×120.

the slide being covered with them, 50 to 100 in a field; in others they were more scanty, sometimes only one or two to a field.

The vaginal plaques likewise vary in their appearance. Three types were observed. In one, the plaques are composed of layers of squamous epithelium, varying in number from 3 to 4 cells to masses of 100 or more (Fig. 6) and from 3 to 4 layers to 10 or 20. Here, too, as in the spindles, the cells are pale staining and apparently non-viable. The second type is represented by plaques of large spheroidal or polygonal cells, probably the variation in the direction of the section making the difference in appearance. The nuclei in both groups are small, round, badly stained, and centrally situated (Fig. 7). The third variety is seen as strands of cells, one or more layers in thickness, crowded, non-nucleated, dark; in many the cell markings are gone. These are just strands of cornified non-viable superficial epithelium (Fig. 8).

The plaques are not as numerous as the cells but are present in sufficient profusion to be easily found. On the first day they occur in 50 per cent of the cases, rising on the second day to 72 per cent, dropping again to 55 per cent on the third day and to 25 per cent on the fourth day. Whether this vaginal cycle is dependent on a true endocrine impulse or results from maceration by the menstrual blood, cannot as yet be determined (Graph B).

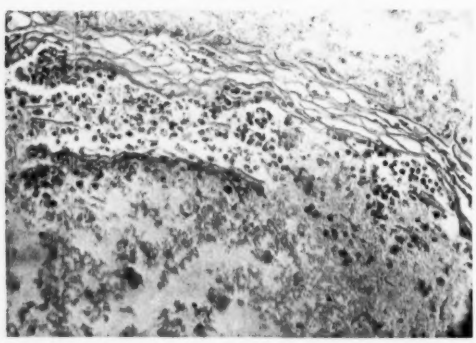
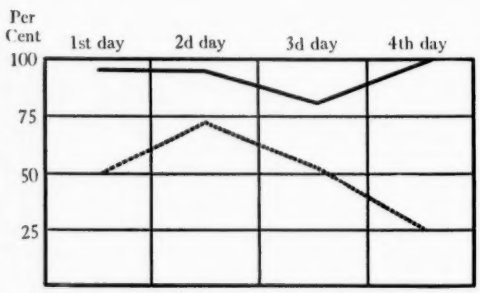


Fig. 9. No. 33230. Vaginal plaque, infiltrated by polynuclear leucocytes showing the penetration of the mucous membrane by leucocytes and the mechanism by which the leucocyte count in the vaginal blood is increased. ×120.



Graph B. Variations in occurrence of vaginal mucosa in menstrual blood. Dotted line represents vaginal plaques; solid line, vaginal spindles.

TABLE I.—SHOWING PERCENTAGE VARIATIONS OF THE OCCURRENCE OF UTERINE AND VAGINAL ELEMENTS ON SUCCESSIVE MENSTRUAL DAYS

	1st day	2d day	3d day	4th day
Uterine epithelium	50	74	25	3
Uterine stroma	75	90	91	4
Vaginal spindles	95	95	82	100
Vaginal plaques	50	72	55	25

Recently Dierks[1] described a cyclical desquamation of the vaginal mucosa corresponding to the cycle of the uterine mucosa. Our findings seem to substantiate his work, but at present we do not feel warranted in accepting all of his findings.

In collaboration with Dr. Allan Guttmacher, I have studied 34 vaginal spreads from women whose menstrual history was known, and the findings suggested that during the menstrual period the sheet desquamation was most common. This work will be elaborated and reported on later (Table I).

A study of the white blood cells shows a striking finding. The number of polynuclear leucocytes varies tremendously. In the majority of the cases, they are fairly numerous, much more than could be accounted for by the presence of the menstrual blood *per se*. In a preliminary study of 20 cases where the leucocyte content of the circulating blood and of the menstrual blood, as it escaped from the cervix, was determined, it was found that while the cases had a normal count in the peripheral blood, the white cell count in the menstrual blood ranged from 1,200 to 5,200. In other words, one of two things must have happened: either the white blood cells when they escape in the menstrual blood, degenerate very rapidly; or the white blood cells do not leave the uterine blood space in the same proportion in which they are present in the circulatory blood. Whether they leave the capillaries and remain in the tissues to perform some reparative function or whether they wander back into the blood stream, cannot at present be answered. It is also possible that because of their greater density they lag behind, adhering closely to the posterior wall and so do not appear in the streaming blood, or that they agglutinate to form some small blood clots, the predominating constituent of these clots being the white blood cells.

To account, therefore, for the increase in the number of white blood cells found in the menstrual blood, contained in the vagina, over the number of white blood cells found in the menstrual blood as it issues from the cervix, some origin other than the blood itself must be considered. It would seem most reasonable to attribute this condition to an exudation through the vaginal mucosa (Fig. 9).

In some instances the number of polynuclear leucocytes was so great as to suggest pus, histologically. In practically all of these cases inflammatory factors were present, either as pelvic exudates or diseased adnexa. On the other hand, in a number of cases, when inflammatory pelvic disease was diagnosed by other criteria, the white cell content of the vaginal menstrual blood did not contain an excess of leucocytes. Apparently the presence of pelvic infection did not always cause an increase in the leucocytic content of the vaginal blood. How to account for this variation cannot be determined at present.

[1]Arch. f. Gynaek., 1927, cxxx, 46.

SUMMARY

In menstrual blood we find a definite number of elements which are so characteristic and stable as to enable us to differentiate with certainty menstrual blood from blood of other types of genital bleeding. This fact is of value in that it gives us an additional diagnostic aid in pelvic diseases accompanied by hæmorrhage.

THYROID TISSUE TUMORS OF THE OVARY

With the Report of an Apparently Toxic Case

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ALTHOUGH about 50 cases of struma ovarii are reported in the literature,[1] the determination of the actual frequency of this tumor type is rather difficult. In view of the fact that Pick found thyroid tissue in 6 out of 21 dermoids, and Rohdenburg saw thyroid tissue 9 times in a series of 500 ovarian tumors, it seems unlikely that struma ovarii is really so rare as the relatively few cases reported would indicate. However, there is no standard to determine whether a tumor containing thyroid tissue should or should not be designated struma ovarii; some men consider any growth containing thyroid tissue as struma ovarii, whereas other authors designate only such tumors as are made up wholly or for the most part of thyroid tissue as belonging to the group of ovarian goiters. Certainly, a differentiation is difficult here. The amount of thyroid tissue present may not always be the important factor (see Case 3 reported here), any more than the toxicity of a neck goiter can be judged by its size.

Aside from these difficulties in determining the frequency of occurrence of such tumors, there is also some question as to how many of the cases reported as struma ovarii really are what they were represented to be, since Bauer in 1924 reported his case of "pseudostruma." This was a cystadenoma of the ovary derived from invaginations of the germinal epithelium of the ovary which resembled thyroid tissue so closely that even Langhans of Bern, to whom the sections were submitted, was convinced that he was dealing with thyroid tissue. Bauer concluded from his case, which he interpreted as a pseudomucinous cyst, that all the so-called thyroid tissue tumors of the ovary are but atypical pseudomucinous cystadenomata and not teratomata at all. Aside from the fact that the morphology and epithelium of the cystadenoma described by Bauer did not seem to fit a pseudomucinous cyst, and that the fluid contents of the tumor were not chemically examined, there are a number of other objections to Bauer's hypothesis, which, however, I do not have to go into here, as I have offered them before[2] following a detailed study of the first two cases presented here. These cases had been seen at the Universitaets Frauenklinik of Tuebingen, just prior to the appearance of Bauer's article.

Case 1. M. J., Hosp. No. 243, 1914. Peasant woman, aged 44 years, married, mother died of "uterine tumor." One brother died of pulmonary tuberculosis. Patient had 8 normal labors and 1 abortion. Last labor occurred July, 1910. Periods always were normal. Last menstruation occurred 1 week before admission to the hospital. The woman sought medical aid because she had suffered for the last few months from very severe pains in the back and burning on urination.

General physical examination revealed nothing of importance, except a small goiter, which, however, is very common in that particular community.

Gynecological findings. On the patient's right side a resilient cystic, intra-abdominal tumor could be felt. It evidently had its origin in the pelvis and extended well up above the umbilicus. The external genitals, urethra, and bladder were normal, but the posterior vault of the vagina was pushed downward by the aforementioned cyst. The tumor was about the size of a large cantaloupe. The cervix uteri was high up behind the symphysis pubis, the uterus normal in size, hard, anteflexed, but misplaced to the left. A definite pedicle leading from the tumor to the side of the uterus could not be felt.

Diagnosis. Cystic tumor of the ovary.

Laparotomy was performed on the patient and showed that the growth, the pedicle of which was twisted twice upon its axis, originated in the left ovary. The cyst together with the left tube was removed. The contents of the cystic tumor, which was punctured to facilitate removal, were thin, watery, clear, and light yellow in color. The right tube was normal. The right ovary contained several small cysts which were punctured.

The patient made an uneventful recovery and was well when last heard from 5 years later.

[1] See literature: Dingels, Ueber d. Anat. u.d. klin. Verhalten d. Struma thyroidea ovarii. Inaugural dissertation, Bonn, 1912; Adolph, Arch. f. Gynaek., 1918, cviii, who collected 40 cases from the literature and reported two more; and Frankel and Lederer—Am. J. Obst. & Gynec., 1928, Sept., who found five more cases and added three of their own, missing however the case of Bolt (Canad. M. Ass. J,. Montreal, 1923) whose case (61 years old) is by the way the oldest patient reported in the literature with struma ovarii.

[2] Ueber Struma ovarii. Ztschr. f. Geburtsh. u. Gynaek., lxxvii, 1915.

Macroscopic description of the tumor. The left ovary, i.e., the cystic growth, was about the size of a large cantaloupe. Its outer surface was smooth except for an encircling depression which divided the growth into two (about equal) halves. The somewhat thickened tube was closely adherent to the upper surface of the growth. The fimbriated tubal end was patent. The walls of the cyst consisted of tough fibrous tissue about one millimeter in thickness. The interior of the tumor was divided into two cavities almost equal in size (*a*, *b*, Fig. 1). The location of this dividing septum corresponded to the aforementioned groove on the outside of the cyst. Immediately below the tube, in the wall of the cyst *a*, and the septum between *a* and *b*, there was a hard mass about the size of a hen's egg (*d*, Fig. 1). On section this proved to be a dermoid cyst filled with hair and sebaceous material. The nucleus of the dermoid cyst (*s*, Fig. 1) was approximately the size of a pigeon's egg and quite firm, with several very hard nodules. The wall of cyst *b* was only loosely connected with this small hard growth.

On transverse section the latter presented the typical picture of a struma colloides cystica, the cysts ranging up to the size of a large pea. Some of the cysts were filled with a light yellow colored colloid, whereas others, in the softer parts of the growth, contained a more milky looking jelly. The contents of some of the transversely cut cysts could be lifted out with a needle in the form of small translucent hemispheres. The cysts were larger in the upper portion of the growth which also was darker in color than the lower half. The smaller cysts in the lower half were, on the other hand, packed very closely together so that this part of the struma looked very much like a mass of solidified glue in which the thin connective tissue walls of the individual cysts could be discerned only as fine irregular lines.

Macroscopically no ovarian tissue was seen anywhere.

Chemical examination. The colloid in the cysts was examined by the Baumann-Ostwald method for traces of iodine. We employed the technique recommended and used by Weinberg in testing for chlorine and iodine in the ovary but were not able to find any iodine. A further chemical examination of the colloid for pseudomucin[1] likewise gave negative results. The negative reaction for pseudomucin cannot be explained by the formalin fixation of the specimen, since it has been shown that pseudomucin will dissolve in weak alkaline solutions, even after weeks of hardening in formalin. The contents of the two larger cysts could not be examined chemically, as they were lost at the time of operation.

Microscopical description of the tumor. Numerous pieces were cut from different parts of the cyst walls and out of the small struma-like nodule. The separate pieces were embedded in paraffin and stained with hæmatoxylin-eosin and according to Van Gieson. I tried to cut the struma serially, but this proved impossible on account of the extreme hardness of the material, and I had to be content with the best sections obtainable at different levels of the specimen.

[1] Hammarsten's method. Handb. d. Gynaek., 1908, iv, 1.

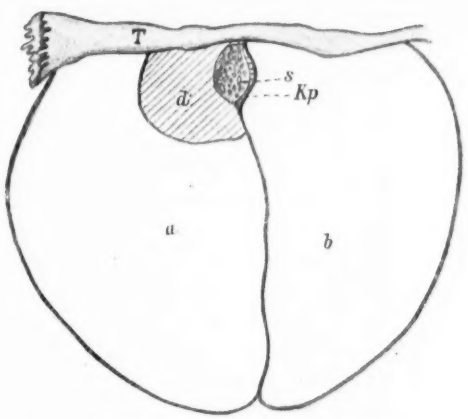

Fig. 1. Diagram of tumor of Case 1. *a*, Cyst; *b*, cyst; *s*, struma nodule (dermoid nucleus); *T*, tube; *Kp*, capsule formed by wall of cyst *b* and only loosely attached to *s*.

The first sections examined were those cut from the struma. Outside of a piece of skin with sebaceous glands found in three slides of this series, the predominating histological picture was that of a typical cystic goiter. Cysts of varying size alternated with clumps and bands of epithelial cells. Usually the cysts were separated from one another only by fine connective tissue trabeculæ (see the struma tissue in Figures 3 and 4), although in some parts of the tumor this connective tissue formed more massive bundles (Fig. 2). A thickening of the connective tissue had also taken place between some of the larger apposed cysts. The fibrous tissue in the last named location was as a rule highly cellular and frequently contained small blood vessels. Each area as a whole was subdivided into lobules by large, more or less hyaline degenerated connective tissue bundles with at times a few smooth muscle fibers. Some of the slides examined showed an invasion of the connective tissue by the struma, although all other evidence of malignancy was lacking.

The smaller struma cysts were lined with low cuboidal epithelium which became flatter in the larger cavities. The protoplasm of the cells was light in color, the nuclei dark, round, or oval. All the cysts contained an almost homogeneous substance which the eosin had stained a brilliant red. In some places this colloid showed vacuoles or darker colored round or oval spots. These latter were probably nothing more than small areas of condensed colloid, best explained by some inner chemical change. Under the higher powers of the microscope the colloid had a finely granular structure and frequently contained desquamated epithelial

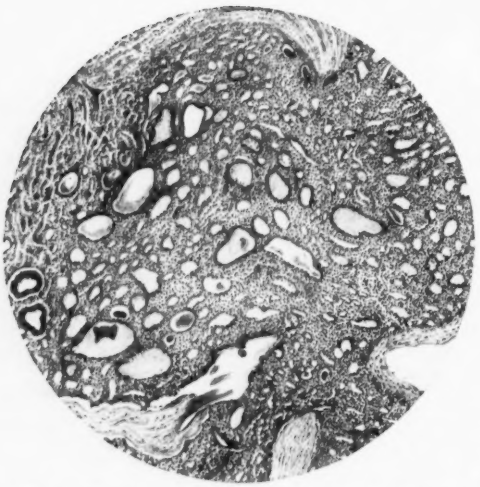

Fig. 2. The struma tissue is interspersed with abundant fibrous connective tissue. The darker areas in the colloid of the larger cysts are probably due to chemical changes. Above in the picture, thick bands of fibrous connective tissue are visible. Below on the right there is a blood vessel. Leitz, ocular No. 2; objective No. 3.

cells, especially in the larger cysts. The latter cysts also frequently showed little papillomata covered with epithelium projecting into the lumen of the cavity. Some of these little excrescences were solid, others contained small cysts of their own. They had exactly the same character as the little papillomata found in goiters of the neck. Such papillomata, however, had to be distinguished from torn remnants of intercystic fibrous partitions. Where small cysts had been cut on a tangent, at times solid cell clusters appeared, but not infrequently the colloid underneath shone through in a faint red color, or would come to the surface in places where the cyst wall had been cut away.

Near the center of the growth the histological picture changed entirely. Instead of struma tissue, a typical adenocarcinoma which was divided into larger and smaller alveoli by fairly thick bands of hyaline degenerated connective tissue was seen. Nearly everywhere there was a sharp line of demarcation between the carcinoma and the struma. Only one spot (Fig. 4) showed a transition between the two types of growth. The goiter here first changed its character to that of a malignant struma and this then acquired more and more a typically carcinomatous aspect until only cancer was present in the microscopic field.

No ovarian tissue was found in the tumor. The capsule of the struma was formed by the wall of cyst *b*. The wall of this cyst was composed partly of connective tissue. The outer layers showed more or less parallel fibers, whereas the inner connective tissue bundles were more irregularly arranged. The connective tissue found in the goiter was derived from the inner strata. It was fairly well supplied with blood vessels, some of which showed a thickening of the walls. Lymph spaces were moderately frequent. In some places deposits of blood pigment were noticed. The cyst wall forming the capsule around the goiter showed no epithelium. There were nowhere any invaginations from the surface and no ovarian tissue whatsoever was discovered. The other sections from the cyst wall showed practically the same structure as described above. Epithelium was seen in but a few places and even there it was not well preserved. The cells were flattened and contained a light protoplasm and small oval nuclei.

The fallopian tube showed a moderate chronic inflammatory reaction but nothing else of importance.

Case 2. F. R., Hosp. No. 279, 1914. Peasant woman, aged 46 years, virgo intacta. The patient had been operated upon when a child "for pus in the right arm." She had had facial erysipelas twice; jaundice once. Her menstruation had always been normal, the last period occurring 2 weeks before admission to the hospital.

The patient came to us because her abdomen had been increasing in size for years, although marked swelling accompanied by occasional shooting pains and œdema of the left leg had been present only during the last 3 or 4 weeks.

Physical examination. Here, as in Case 1, was found a struma colli about the size of a hen's egg. The left leg was normal at the time of the examination, but the right leg now showed œdema. The heart was slightly enlarged. On the right arm was an old scar (see case history).

Gynecological findings. The woman had a circumference at the waistline of 106 centimeters. The whole abdomen up to the costal margin was filled by a resilient smooth cyst. The anterior vaginal fornix was pushed downward by the growth. The uterus was a trifle small, hard, retroverted, and pushed toward the left. The pedicle of the tumor was attached to the right cornu of the uterus. The left ovary could not be made out.

Diagnosis: right sided large ovarian cyst with pressure symptoms. Uterus rather small.

Laparotomy was performed and the cyst punctured and removed together with the right tube and the cystic left ovary and left tube. The woman made an uneventful recovery and was well when last heard from 5 years later.

Macroscopic description of the tumor. The extirpated cyst originally must have been about the size of a full-term pregnant uterus. There was one very large cyst (*a*, Fig. 5) about twice the size of an adult's head and a number of smaller cysts, *b*. The outside of the tumor was smooth except for the bulging caused by some of the smaller cysts. The tube was thickened and elongated and ran along the upper and anterior surface of the growth. The con-

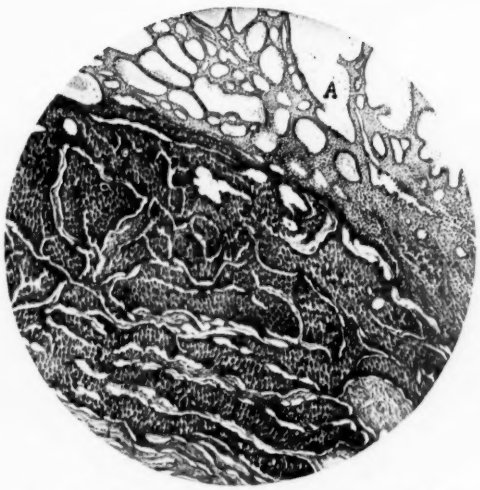

Fig. 3. Above, colloid cysts of larger size than in Figure 2 are present, also small papillary projections into the lumen of the cysts and at *A* remnants of a torn intercystic wall. Below there is a typical alveolar carcinoma separated definitely at all points in the picture from the struma. Leitz, ocular No. 2; objective No. 3.

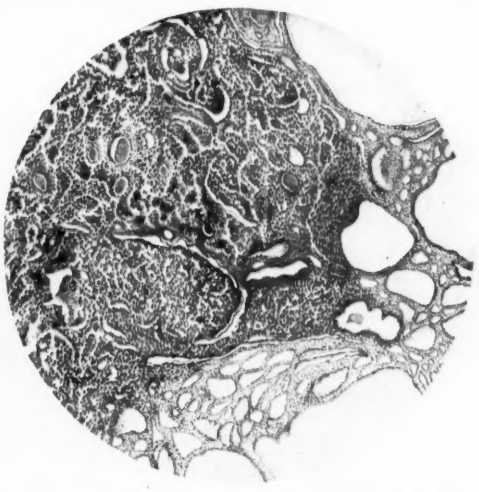

Fig. 4. Transitions are seen here between the struma on the right side and the carcinoma. Near the center numerous small colloid cysts are still present in the carcinomatous tissue. Leitz, ocular No. 2; objective No. 3.

tents of the main cyst were clear and watery (as found on puncture at the time of operation), whereas the contents of many of the smaller cysts were turpid, looking very much like pea soup. The walls of the individual cysts were rather thin. Their structure was similar to that described in Case 1. There were dense fibrous adhesions between the tube and the cyst wall. The latter was also greatly thickened in this location. At one point a calcification (*k*, Fig. 5) was present. The calcified area was about the size of a penny and of a yellowish color. At this same place the capsule of the tumor (teratoma) was much thickened.

Below the fallopian tube and near its uterine end another cyst about the size of an orange was present (*c*, Fig. 5). The inside of this cyst appeared yellow and leathery and showed numerous calcific deposits. This inner layer was pretty tough and could be stripped off from the outer fibrous layers. In the wall of the cyst, *c*, an irregular nodule, *d*, about the size of a hen's egg was seen. This was covered by tough connective tissue and showed numerous small calcific deposits on its outer surface. It was quite hard and proved to be a teratoma which on section was very firm and nearly solid. Its color was reddish and the tumor gave the impression of being composed of muscle and fibrous connective tissue. A cyst, *e*, about the size of a large marble was also present. Its wall was smooth and calcified, about 2 millimeters thick. From the periphery of this cyst a nodule, *f*, looking like cartilage and about the size of a pea protruded into the substance of the above described teratoma. At another point of the cyst wall, *e*, a nodule, *g*, in every way similar to *f* was seen. At the side of the teratoma, *d*, there was a bluish mass about the size of a large filbert, *s*. This also showed areas of calcification both on the surface and in its walls. On section it showed the typical structure of a cystic goiter duplicating the macroscopic picture of the sectioned nodule *s* in Figure 1, Case 1. One-half of the nodule (struma s^1) did not show much colloid, and in some places cartilage-like structures were present. Near the poles of the teratoma and in the cyst wall surrounding *d* there were very hard, closely adherent struma-like nodules s^2, which differed from s^1, only in being smaller. The cyst walls of *a* and *c* formed only a loose covering over the struma. One may perhaps be surprised at the number of struma-nodules (seven altogether) present in this tumor, but multicentrally developed tumors do occur, and multiple dermoids have been described, for instance, by Wilms. It is also possible that some of the nodules may have been metastases.

The left ovary was cystic, about as large as a hen's egg, and showed only small remnants of ovarian tissue around the hilus. The left tube was slightly thickened but otherwise normal.

As in the first case, a chemical examination for iodine was carried out but again was negative. The watery clear fluid content of the main cyst and the colloid of the struma were examined for pseudomucin also with a negative result. The fluid contents of the other cysts were no longer available at the time of the pathological examination.

Microscopic description. Numerous pieces of tissue were excised from different parts of the cyst wall

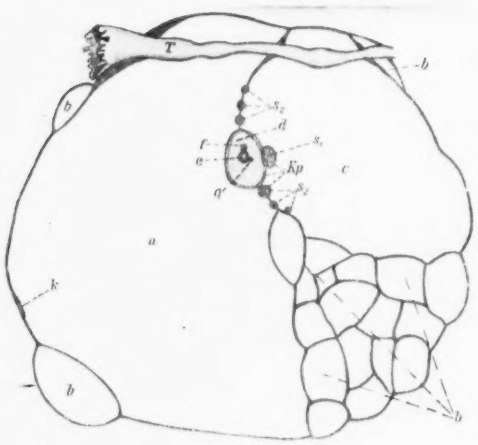

Fig. 5. Diagram of tumor in Case 2. *a*, Main cyst; *b*, daughter cysts; *c*, cyst, size of orange; *d*, teratoma; *e*, calcified cyst; *f* and *g*, cartilage-like bodies; s^1, main struma nodule; s^2, other small struma nodules; *t*, tube; *k*, calcified area; *kp*, capsule formed by walls of cysts *a* and *c* and loosely attached to the various tumors.

and the various solid tumors. Serial sections were, as in the first case, impossible because of the density of the colloid material, and one had to be satisfied with numerous sections taken at different levels. Cyst *c* and the surrounding tissues were decalcified and embedded in celloidin and the other tissues in paraffin. Sections were stained with hæmatoxylin and eosin, Van Gieson's stain, and with "hæmalaun" for glycogen according to the method advocated by P. Meyer.

Sections from the struma-like areas of the second case showed microscopically just as in the first case the typical structure of a cystic goiter. Here, too, parvicellular or even hyaline connective tissue areas separated the various colloid-filled cysts. In the thicker, fibrous bands lymph spaces were present and sometimes calcified areas.

Although the above was the general picture, some sections showed, interspersed with the struma tissue, large areas of lightly staining polygonal cells with small rounded nuclei (Fig. 6). These light cells on first sight resembled the Langhans decidual cells described by Pick in his epithelioma chorioectodermale and in some places even showed a slightly alveolar arrangement, similar to that present in the syncytial structures in Pick's cases. Moenkeberg, however, believes the tumor described by Pick to have been of endothelial origin, and it is to be admitted that our cells in their arrangement did resemble somewhat an endothelioma or more exactly a perithelioma (Fig. 6), since they seemed to be arranged around the vessels. Nevertheless, endotheliomata of the ovary, although they have been described (Burckhardt-Schlagenhaufer, etc.), are rare and the cells in our case, if we were really dealing with an endothelioma, would then have to have been derived from the endothelium of the vessels. This, however, seemed unlikely as no connection between the described large light cells and the vessel walls, which were everywhere distinct and separate, could be seen.

These large light cell areas likewise did not resemble a carcinoma (Michel interprets Pick's epithelioma chorioectodermale as a carcinoma), since evidence of malignancy could nowhere be detected. A hypernephroma or renal tumor seemed also histologically impossible. The more we studied these cells, the more they seemed to us to resemble the parathyroids, especially in view of the fact that in some areas these light cells were surrounded directly by the struma and thus presented a picture similar to that seen in a struma colli which has engulfed a parathyroid gland. Such an occurrence is rather rare in goiters of the neck, but mixed tumors which are not subject to the usual normal restraints of growth can be expected to be more likely to present such heterotopically placed tissue. It is, of course, not surprising that these light cell areas in this tumor are not histologically easy to identify, since they are made up of apparently still more or less embryonal and not fully ripened or differentiated cells.

The sections just described also showed near the center a darker spot about the size of a pinhead. Microscopically this area again showed the described polygonal cells except that these were stained more deeply and histologically gave the impression of being older. The cells formed an almost solid area which was entirely surrounded by the struma. Small blood vessels and fine connective tissue fibers were seen at the periphery of these cell masses, and some fibrous tissue bands also passed between the individual rows of cells. These characteristics were especially prominent around the few hollow areas (artefacts)

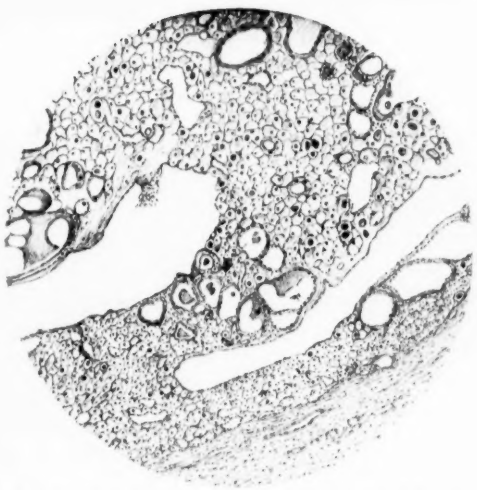

Fig. 6. The large cavities below and to the right are blood vessels. These are closely surrounded by the large light staining cells, but no direct connections are visible between these light cells and the blood vessels. The large cavity on the left is an artefact (probably originally a small vessel). Some small thyroid cysts, some of which contain colloid, are also present. Below, dense connective tissue is seen. Leitz, ocular No. 2; objective No. 3.

Fig. 7. Somewhat higher magnification of the cell masses seen in Figure 6. The cavities present here are nearly all artefacts. Below, struma cysts and blood vessels are present. Leitz, ocular No. 2; objective No. 6.

which were lined by broken and torn remnants of cells. The similarity of this whole area to parathyroid structure was very striking (Fig. 7), slight differences in various cells being probably explainable on the basis of varying degrees of differentiation.

Numerous sections were now stained for glycogen (method of P. Meyer) but with negative results. This may have been due to the formalin fixation. On the other hand, the cells here were definitely young cells and glycogen is found especially in older cells. Furthermore, metaplasia may have played a rôle here. We now interpreted the previously described light cell masses as being of the same character as the ones last described and regarded them all as proliferations from one or more engulfed parathyroid glands analagous to a parastruma colli. Such a proliferation may have been synchronous with the struma growth or secondary in reaction to the stimulus given by the thyroid tissue.

Since I feared that subjectivity might lead me to interpret these cells as of parathyroid origin, I submitted my sections to Professor Paul von Baumgarten, who was kind enough to study them, and who substantiated my diagnosis.

The next slides examined (piece from teratoma *d*, near the calcified cyst *e*) showed a part of what macroscopically was thought to be cartilage. It was found, however, to be only hyaline connective tissue with some areas of calcification. The rest of the specimen again consisted of typical struma also containing areas of the described light cells. Another piece of tissue likewise showed struma, but more fibrous connective tissue and muscle. The latter was invaded to a greater or lesser extent by the struma, but the histological picture of malignancy was lacking. The light cell areas were here also seen and seemed at times to change gradually but directly into struma tissue (according to Blum, cited by Biedl "Internal Secretion," transitions of the cells of the two organs do occur).

The sections containing the original calcified cyst, *e*, Figure 5, were examined next. The wall of the cyst was composed of dense hyaline connective tissue with one area slightly resembling bone. True bone, however, was not seen. The main portions of the sections were again made up of struma which here also invaded slightly the surrounding fibromuscular tissue. On one side of the section, but separated from the struma by dense connective tissue, there was typical salivary gland. Such tissue has been previously found in teratoma.[1]

[1] Handb. d. Gynaek, 1908, xli, 235.

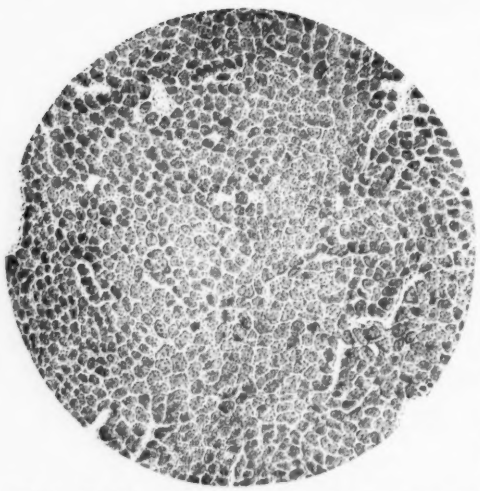

Fig. 8. Portion of the tumor with the appearance of salivary gland tissue. Below and on the left there are indications of excretory ducts (radially arranged slits). Some blood vessels also are seen in the tumor. Its lobular structure is not apparent in the figure because the microscopic field was too small to show it. Leitz, ocular No. 2; objective No. 3.

The salivary gland tissue in our case was divided into lobules by connective-tissue bands, while finer bands split up the lobules into acini. There were no typical ducts, but indications of the same were seen (Fig. 8).

Sections from the cyst walls showed the same structure as those from the cysts *a* and *b* in the first case. No epithelial lining was visible and no ovarian tissue.

In the second case also the capsule was only loosely connected to the teratoma and the struma nodules. The leathery interior layer of the one cyst consisted of hyaline connective tissue in which blood pigment deposits were present.

Tubular structures and surface invaginations, such as Bauer described, were nowhere even as much as indicated. The fallopian tube showed chronic inflammation. The cyst of the left ovary was unilocular, the walls composed of thin connective tissue and the epithelial lining flat and non-ciliated. Near the hilus remnants of apparently functioning ovarian tissue were seen.

Cases such as the two here described speak strongly against Bauer's conception that all the cases described as struma ovarii are in reality unusual pseudomucinous cysts. In neither one of the two cases was pseudomucin found chemically in any of the cyst contents, and certainly the first case was morphologically not at all like a pseudomucinous cyst. Both cases were teratomata and the second contained what apparently was parathyroid tissue. In fact, even trachea and bronchi have been found in close association with the strumatous portions of an ovarian tumor (see my previous article). Gottschalk has also demonstrated[1] a dermoid derived apparently not from the ovary but from the pelvic connective tissue which contained a struma. Following my article Simona and Kafka have likewise offered objections to Bauer's view. Kraus, and especially Kafka, have used special methods of staining (Unna's acid, fuchsin tannic acid solution, and polychrome methylene blue) to identify colloid, of which they have shown three forms, (fuchsinophilic, fuchsinophobic, and tannic acid fast). We have found the same three colloid forms in struma ovarii cases. At the same time it must be mentioned that Wail has denied the correctness of the interpretation of Kraus' staining reactions. While it is true that Kraus has answered Wail[2] and it is also true that Robert Meyer and also Schauta have found iodine in ovarian thyroid tissue, and Kaufmann himself[3] still recognizes struma ovarii as a form of teratoma and states that only at times may it be closely simulated by a pseudomucinous cystoma ovarii, there still remains a certain amount of doubt as to whether or not we are actually dealing in this form of ovarian tumor with true thyroid tissue. Such doubts can be finally allayed only by cases in which the struma ovarii really is functionally active. I do not stress the fact that both of my cases had a struma colli since goiters are so very frequent in some parts of southern Germany. For the same reasons, I do not rate very highly other cases of struma ovarii associated with struma colli (see Walthard, cases 1 and 3; Kretschmer, and Bell, case 2; and others), and I cannot

[1] German Gyn. Soc. meeting, Giessen, 1902.
[2] Arch. f. path. Anat., 1923, ccxliv, 299.
[3] Bauer's article appeared from Kaufmann's laboratory.

necessarily consider Morgen's first case, in which an atrophy of the thyroid gland, without symptoms of myxœdema, and a struma colli were present together as very convincing, since such atrophy need not necessarily be interrelated with a tumor of the ovary, and even a small amount of thyroid tissue left in the atrophic gland may prevent symptoms of myxœdema. From the morphological standpoint, Morgen's cases, especially the second one, are, however, quite convincing.

There are nevertheless some cases in the literature in which the struma ovarii may perhaps have functioned. Trapl extirpated a struma ovarii after which, due to thyroid enlargement, the patient's neck grew from less than 32 centimeters in circumference at the time of operation to 33.5 centimeters 9 months after operation. For a time a quickened pulse and a tremor of the extended fingers were also present. The patient was otherwise normal and her genital organs were negative. Whether we can attribute the described changes here to thyroid activity following the removal of functioning thyroid tissue in the ovary is nevertheless somewhat doubtful.

Kovaćs, however, described a case which seemed to present real evidence that functioning thyroid tissue was present in the ovary. The patient had a struma ovarii both morphologically and chemically and, in addition, signs of exophthalmic goiter at the time of operation. The symptoms all disappeared after the removal of the tumor. This case is the only one of its kind that I have been able to find in the literature. It is interesting, therefore, that recently I saw another case of struma ovarii in which a functional activity of the ovarian thyroid tissue at least seems to have occurred.

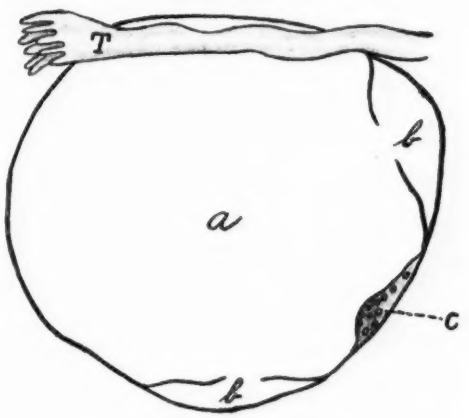

Fig. 9. Diagram of tumor of Case 3. *a*, Main cyst; *b*, daughter cysts communicating with main cyst; *c*, thickened portion of cyst wall with teratomatous nodule; *T*, tube.

This patient, M. B., private case, was seen by me at my office, August 20, 1927. She was 49 years old, a housewife, married 32 years. Family history was negative. The woman had had 6 children, 30 to 20 years ago, and 2 induced abortions 8 and 6 years ago. Menstruation had always been rather scanty and occurred only every 6 to 8 weeks. Last period was 2 years ago. Constipation of rather marked degree was present.

For the last year the patient had had pains in the right side of her abdomen and frequent urination. These symptoms were gradually becoming worse and the abdomen was increasing in size.

General examination disclosed a short, stout woman, with large, fat, somewhat tense abdomen. The lungs were normal. The heart was normal in size and the heart sounds were irregular in rhythm and quality, and extrasystoles occurred from time to time. There were fine tremors of the fingers. The tongue was negative and showed no tremor. Urine was negative. Blood pressure was 154–95 mm. Hg. I regarded the heart lesion as functional and the internist who was consulted confirmed this.

Gynecological examination. The abdomen was fat, and rather tense. In it a cystic movable mass about the size of a honey dew melon could be felt. The external genitals were negative, except for a somewhat relaxed pelvic floor and a slight cystocele and rectocele. The cervix, above the interspinous line, showed an old, healed laceration; the uterus was small and anteflexed. The left adnexa were normal; the right could not be felt but the cystic tumor described above lay mainly on this side.

Diagnosis. Right sided ovarian cyst.

Laparotomy was performed a few days later and the ovarian cyst and right tube were removed intact without any difficulty and the stump peritonized. The patient stood the operation well and made an uneventful recovery except for a very interesting change in her heart. On making rounds 2 days after the operation I noticed that the pulse seemed more regular than before, and an examination of the heart confirmed this opinion. The pathological examination of the tumor at this time was not yet finished, and I hurried it as much as possible. Three days

Fig. 10. Thickened portion of cyst wall. Above is seen the fibrous connective tissue forming the wall of the main cyst. Below is struma tissue. The large clefts in the picture are artefacts. Leitz, ocular No. 2; objective No. 3.

Fig. 11. Nodule of tumor projecting into lumen of main cyst. Above teratomatous constituents and above that is seen the lining of the inner surface of the cyst which at the left passes into the stratified squamous cell epithelium present in this area. Below again is struma tissue. Leitz, ocular No. 2; objective No. 3.

later, that is, 5 days after the operation, the heart was perfectly normal in its action, and the consulting internist 2 days later corroborated this. The tremor of the fingers was now also much less marked.

The pathological examination showed an ovarian cyst with thyroid tissue in it. We regretted exceedingly that we had not done a basal metabolism test on the patient, but this omission is, I believe, to be pardoned as one ordinarily does not think of doing such a test in an otherwise simple ovarian cyst case.

The pathological examination showed the following:

Macroscopic description. The specimen consisted of an ovarian cyst and attached fallopian tube (Fig 9). The cyst was smooth on the surface and measured 16.8 by 16.5 by 9.2 centimeters. On section the contents were watery, thin, and of a straw color. The cyst was in the main unilocular (*a*, Fig. 9) but had some daughter cysts (*b*, Fig. 9), which, however, were in communication with the main cyst. The cyst wall was fibrous and fairly thin in most places. At one place (*c* ,Fig. 9), however, the cyst wall was 1.5 millimeters thick. At this point a small nodule the size of a filbert and discolored by hæmorrhagic infiltration was seen. On section this nodule contained numerous small cysts filled with a brownish red material which suggested colloid of thyroid origin. The thickened area of the cyst wall on section was made up in part of similar colloid-containing cysts.

The fallopian tube was 7.5 centimeters long and 0.7 to 1.2 centimeters in diameter. It was tortuous. The fimbriated extremity was patent.

Microscopic examination. Numerous sections were taken from various portions of the tumor, especially from the described nodule and thickened portion of the cyst wall. They were embedded in paraffin in the usual way and stained with hæmatoxylin, eosin, Van Gieson's stain, and according to Kraus's method for colloid.

Sections from the cyst wall showed it to be composed of dense fibrous connective tissue with some small blood vessels and a few lymph spaces. The epithelial lining had been lost in some places but other areas showed a low cuboidal epithelium with here and there a few cilia. The sections from the thickened area of the cyst, *c*, apparently represented the original area about the hilus of the ovary. Remnants of ovarian cortex with a few immature follicles and numerous corpora albicantia were here visible. The stroma was rather lightly packed together and showed areas of rarefaction (Figs. 10 and 11). Many small and some larger blood vessels and lymph spaces were present.

Toward the interior of the thickened area there was a flattened nodule which was composed of numerous cysts of varying size. Some were filled with rather dense masses of secretion which stained red with eosin. Other cysts were bare of this colloid-like secretion. The epithelium everywhere was cuboidal, usually somewhat higher in the small cysts than in the larger ones. The intervening stroma showed occasional collections of round cells and lymphocytes arranged more or less in the shape of follicles (Fig. 10). Some of the cysts showed at their

peripheries solid buds of cells; others showed these buds with a small lumen of their own. In some of the larger alveoli there were knob-like excrescences and protrusions into the lumen, the epithelium here being higher than in other places. The cysts often also showed extravasated red blood cells, desquamated epithelial cells, and various types of pigment, hæmofuscin, and iron pigment. The described nodule which protruded into the lumen of the large cyst (*a*, Fig. 9) on section showed a structure similar to the one just described. In addition there were numerous hair follicles and sebaceous glands present. The surface of the nodule was covered by stratified squamous epithelium which in some areas was cornified and went over into the columnar epithelium lining the large cyst cavity (Fig. 11). This thickened area in the cyst wall was, therefore, a teratoma or dermoid containing what appeared to be typical thyroid tissue and resembling a toxic goiter in the resting stage. Further staining reactions according to the method of Kraus also showed all three forms of colloid (fuchsinophilic, fuchsinophobic, and tannic acid fast) to be present. A chemical test for iodine was, however, negative. Due to the press of work the contents of the large cyst were not examined, but the whole morphology of the tumor excludes with certainty a pseudomucinous cyst.

The fallopian tube showed a congested thickened wall with a slight chronic inflammatory reaction.

The follow-up of the patient showed her to be in excellent health 3 months, 6 months, and 13 months after operation. The heart has remained perfectly normal in rhythm and quality.

We have here then a third tumor, certainly not a pseudomucinous cyst containing thyroid tissue. Since the tumor was too small to have caused irregular heart action from pressure and an ovarian cyst in itself does not disturb heart action, and since the rest in bed cannot be considered to have returned the patient's heart action to normal, as this has remained so ever since, it is perhaps not too far fetched to attribute the change in the heart action to the removal of actually toxic thyroid tissue contained in the ovarian tumor. There is, at any rate, no other assignable reason for such a change and the case shows how comparatively small an amount of thyroid can influence metabolism.

SUMMARY

In view of these 3 cases, especially the last one, which seems to have contained actually functioning thyroid tissue, we must deny Bauer's assumption that cases of struma ovarii are really pseudomucinous ovarian cysts or even cystadenomata ovarii at all. They are teratomata, perhaps not so rare as commonly supposed, but extremely rare as far as actual functioning of the thyroid tissue is concerned, this being only the second tumor described in the literature in which the assumption of functionally active thyroid tissue in an ovarian teratoma seems really justified.

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THE PATTERN OF SENSORY RECOVERY IN PERIPHERAL NERVE LESIONS[1]

LEWIS J. POLLOCK, M.D., CHICAGO

ONLY scanty references to the pattern of sensory recovery, often incomplete and faulty, may be found in the literature dealing with injuries to the peripheral nerves. Comparing the sensory charts of complete lesions with those of recovering ones, some interesting observations have been made which merit description.

For many years it has been noted that the total loss of sensation is limited to a much smaller area than one would expect from its anatomical distribution. It has been well recognized that the residual sensibility of a nerve is more extensive than its accepted anatomical distribution.

It has likewise been noted that about 50 days or so following suture of a nerve, the area of analgesia begins to shrink. This early return of sensibility to pain has been attributed to an early regeneration of protopathic fibers.

In some previous publications[2] I stated my opinion that this early and dissociated return of sensibility to pain is due to the assumption of function of adjacent uninjured nerves. It is felt that this is true because: First, the return of sensibility to pain always occurred in certain areas of skin supplied by the various nerves. Second, when one or more adjacent nerves were injured simultaneously, sensibility to pain never returned in the borders between these nerves, where it usually returned when either of these nerves was injured alone. Third, when there was a return of sensibility to pain in a region of sensory distribution of a severed nerve this region became analgesic when an adjacent nerve was severed; for example, to be used as a cable transplant. Fourth, when sensibility to pain had returned in a region in the area of sensory distribution of a severed nerve, subsequent resection and suture of this nerve was not followed by a loss of this sensation.

The return of sensibility to pain in such cases follows a pattern so characteristic that it may be recognized at sight. It never returns in the distal phalanges of the little finger in ulnar nerve lesions, never in the distal phalanges of the index and middle fingers in median nerve lesions, and so on. It always occurs along the borders of an uninjured nerve and may well be described as a shrinkage (Fig. 1).

Contrasted with this, the pattern in recovering nerves is strikingly different. Although shrinkage occurs, other changes are always present. A certain degree of standardization is necessary, if the observations of one investigator are to be utilized by another.

Examination for tactile sense is now generally done by means of a wisp of cotton, care being taken to shave hairy parts. In the examination here recorded, cold sense was detected by means of a wisp of cotton moistened with ether. This procedure permitted rapid examination of closely adjacent areas of skin, and a gradient of sensory loss could be easily estimated. It was noted in our study that in complete lesions the area of loss of cold sense thus examined was practically coextensive with tactile anæsthesia. Frequently the border was slightly outside that of touch. Little overlap for this degree of cold was ever noted. It has been stated that if one examines for analgesia with low degrees of pressure, 15 grams, the area of analgesia will be coextensive with that of touch, and if increasingly greater pressure be used, the area will shrink and give rise to fallacious interpretation of return of pain sense. This may be true, but it is well to remember that if *any* sensation to pain is present it can only be the result of regeneration of the injured nerve or assumption of function of an adjacent uninjured nerve. Therefore, return of sensibility to pain in the isolated supply of a nerve is evidence of regeneration, however great the pressure used to test pain sense.

[2] POLLOCK, LEWIS J. Overlap of so-called protopathic sensibility as seen in peripheral nerve lesions. Arch. Neurol. & Psychiat., 1919, ii, 667–700.

[1] From the Department of Nervous and Mental Diseases, Northwestern University Medical School, Chicago. Read at a meeting of the Chicago Neurological Society, December 21, 1928.

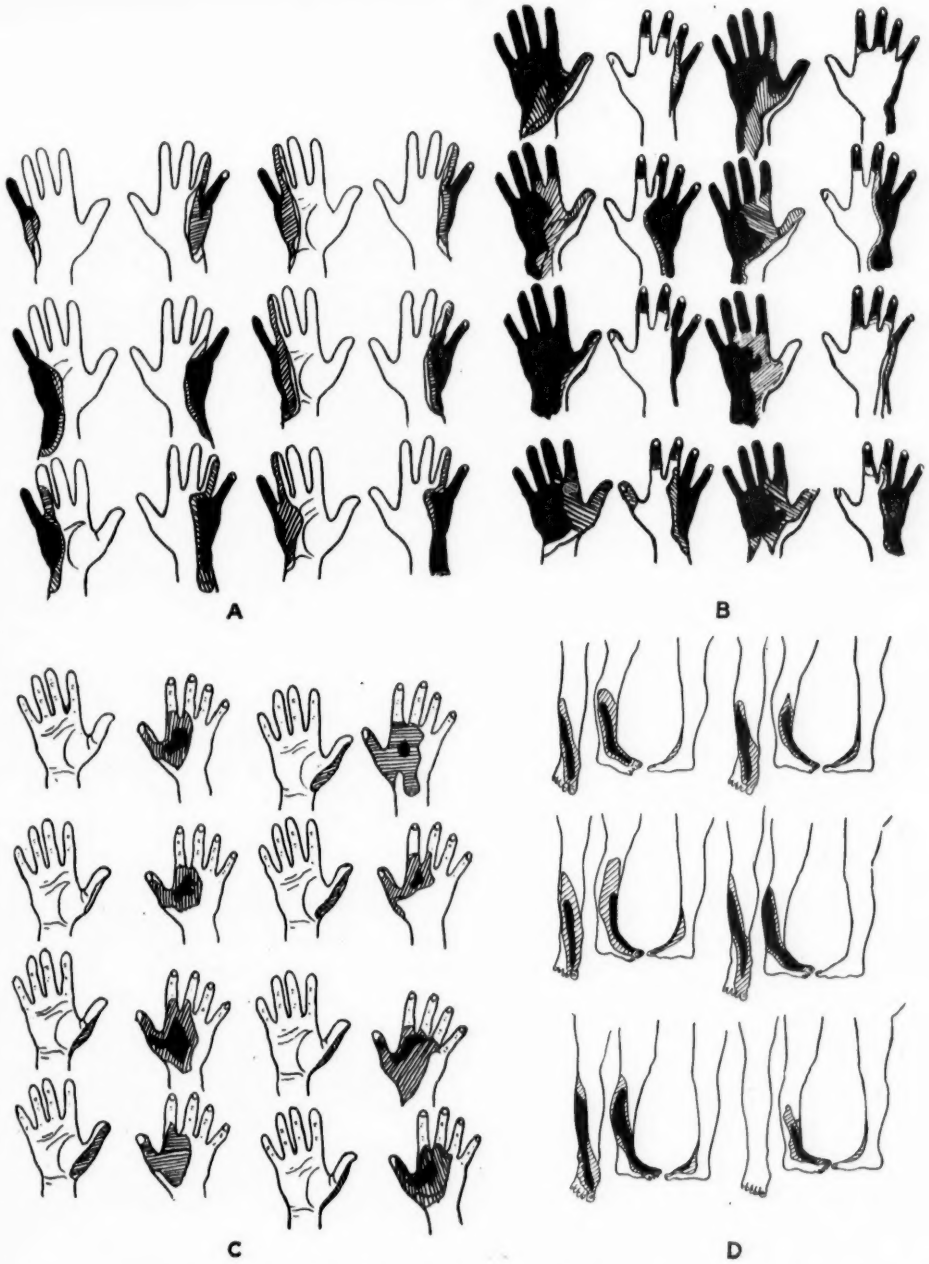

Fig. 1. Sensory loss in complete section of A, ulnar nerve; B, ulnar and median nerves; C, radial nerve; D, external popliteal. Black, loss of pain, touch, and temperature; shading, loss of touch.

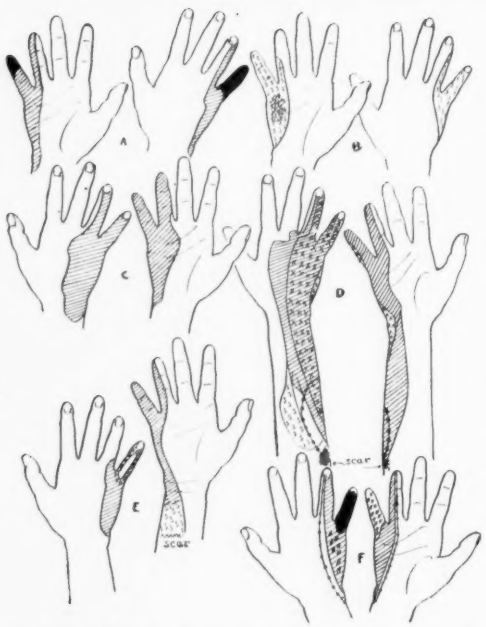

Fig. 2. Ulnar, spontaneously recovering. A, Rare severe lesion, marked sensory loss; B, recovery of pain in isolated supply, diminished loss of touch; C, recovery of pain; D, recovery of pain in isolated supply, recovery of cold; E, recovery of patch of pain and touch; F, diminished loss of pain in isolated supply, recovery of touch. Black, loss of pain, touch, and temperature; shading, loss of touch; circles, loss of temperature; letter *S*, hypæsthe ia; crosshatch (#), hypalgesia; letter *X*, analgesia.

Inasmuch as pain elicited by greater degrees of pressure often returns before tactile sense, and probably the co-extensive loss of pain sense to very light degrees of pressure, it cannot be emphasized too strongly that although lighter degrees of pressure accurately recorded by an algesiometer should be used in studying sensory loss, one should never neglect to use greater degrees of pressure. The charts of the material here studied represent the analgesia obtained with 30 grams of pressure.

The material consisted of about 400 cases. The general conclusions are derived from the whole material, from which has been selected a number of cases recovering after operation contrasted with those recovering spontaneously. No difference could be detected between the cases recovering following neurolysis and resection and suture, except in

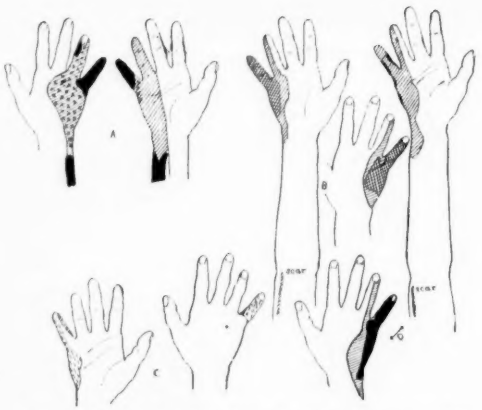

Fig. 3. Ulnar, postoperative. A, Extensive sensory loss, motor recovery; B, diminished loss of pain; C, patchy recovery of touch and complete recovery of pain; D, recovery of pain in isolated supply of nerve. Black, loss of pain, touch, and temperature; shading, loss of touch; circles, loss of temperature; letter *S*, hypæsthesia; letter *X*, analgesia.

those in which prior to the neurolysis the sensory loss did not occupy completely the sensory cutaneous distribution of the nerve. Here very early return of function in the partly anæsthetic or analgesic area was found.

Ulnar nerve lesions in general showed a larger number with little sensory recovery when motor recovery had begun.

In those spontaneously recovering, recovery of pain sense as well as diminution of degree of analgesia in the isolated sensory supply of the nerve was frequently noted. Return of pain and touch in patches occurred. Areas of return of pain and cold and persistent anæsthesia were noted. Almost complete return of sensation to cold with anæsthesia and analgesia was observed. In the cases recovering following operation the loss to pain sense was generally greater; the same general characteristics were found. Particularly interesting were the areas of recovery of tactile sense in indentations and fissures (Figs. 2 and 3).

Median nerve lesions spontaneously recovering showed in a number of instances areas of return of sensibility to touch and not to cold. More frequently, cold had returned in areas whereas touch had not. Interlacing of the border of loss of cold was seen. Patchy return of tactile sense and pain sense was

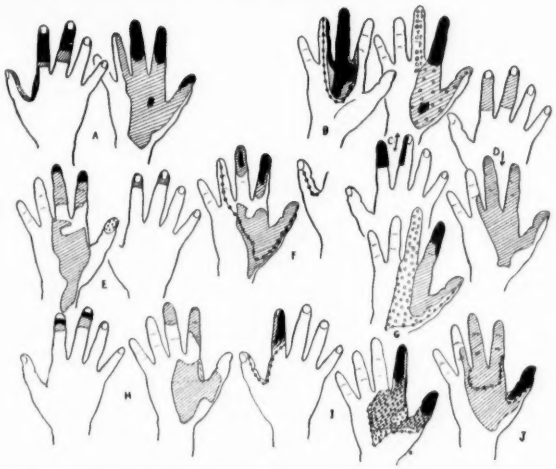

Fig. 4. Median, spontaneous recovery. A, Motor recovery, severe sensory loss; B, unusual distribution of sensory loss; C, recovery of touch, not pain or cold; D, recovery of pain and cold, not touch; E, patchy recovery of touch; F, patchy recovery of touch; G, recovery of touch and pain, not cold; H, patchy recovery of touch; complete recovery of pain and cold; I, recovery of touch and pain, not cold; J, recovery of cold, not touch. Black, loss of pain, touch, and temperature; shading, loss of touch; circles, loss of temperature; letter *X*, analgesia, letter *S*, hypæsthesia.

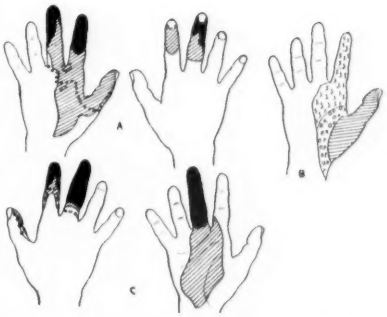

Fig. 5. Median, postoperative. A, Slight interlacing of cold; recovery of cold, not touch; end-to-end suture; B, nodule excised; recovery of pain in isolated supply; diminished tactile loss; C, neurolysis; no analgesia or anæsthesia of index finger. Black, loss of pain, touch, and temperature; shading, loss of touch; circles, loss of temperature; letter *S*, hypæsthesia; letter *X*, analgesia.

observed. Partial lesions often showed sensory loss of only part of the sensory supply of the nerve. As a rule, the cases recovering after operation showed less recovery to pain. When motor recovery had begun, sensory recovery could often be seen (Figs. 4 and 5).

Radial nerve lesions in many instances showed areas of loss of cold with recovery of tactile sensation. In lesions of this nerve, the return of sensibility to pain alone cannot be given much weight in relation to regeneration, because of the very wide overlap of adjacent nerves. Patchy return of sensation, interlacing of the borders of loss to cold, areas of recovery of tactile sense and not of cold, and the reverse, as well as the recovery of tactile sense in the sensory supply of the nerve, served to determine the existence of a process of recovery. In some cases a widespread anæsthesia was present, but a deep indentation (Fig. 6A) pointed to a correct diagnosis. Similarly (Fig. 8C), a wide anæsthesia and analgesia would have been deceptive had not the border of the loss to cold been well outside this area, and interlacing of cold been present (Figs. 6 and 7).

Combined ulnar and median nerve lesions illustrated very well the return of sensibility

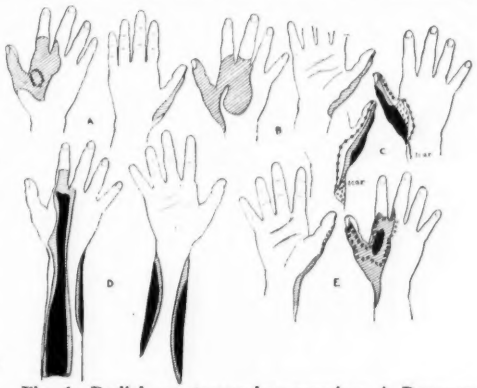

Fig. 6. Radial, spontaneously recovering. A, Recovery of pain, small area of loss of cold; B, recovery of pain and cold; C, injury of superficial sensory nerve; recovery of touch, not pain; D, recovery of all motor branches; marked sensory loss; E, recovery of cold, not touch. Black, loss of pain, touch, and temperature; shading, loss of touch; circles, loss of temperature; letter *X*, analgesia.

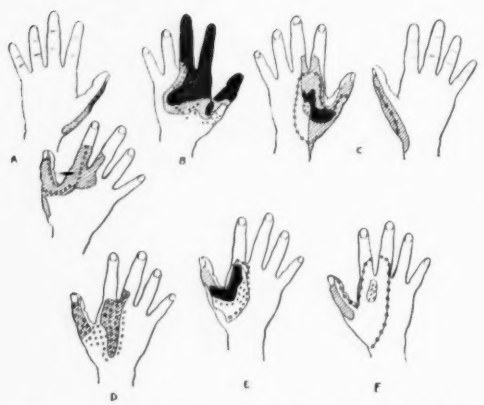

Fig. 7. Radial, postoperative. A, Return of pain, not cold; B, radial and median showing considerable analgesia; island of analgesia; C, recovery of touch, not cold; touch, not pain; D, return of touch, not pain, in a patch; the shaded area showed only tactile hypæsthesia; E, return of touch, not pain or cold; F, recovery of touch and pain, not of cold. Black, loss of pain, touch, and temperature; shading, loss of touch; circles, loss of temperature; letter *X*, analgesia.

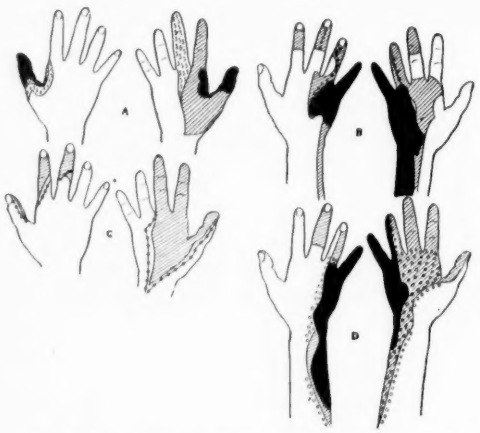

Fig. 8. Ulnar and median, spontaneously recovering. A, Complete recovery of ulnar; recovery of pain in isolated area of median and diminished tactile loss; B, ulnar marked sensory loss; median recovery of pain, touch, and temperature sense in isolated supply; C, ulnar recovery. No loss of pain in median, marked loss of cold; D, recovery of cold and temperature sense in isolated supply of median. Black, loss of pain, touch, temperature; shading, of touch; circles, of temperature; *S*, hypæsthesia; *X*, analgesia.

in the area between the borders of their respective sensory supply, which never occurs in complete lesions. Interlacing, patchy return, return of sensibility in areas of isolated sensory supply, dissociation of loss to cold and anæsthesia occurred (Figs. 9 and 13).

Brachial plexus lesions showed all of the mentioned characteristics. Patchy recovery

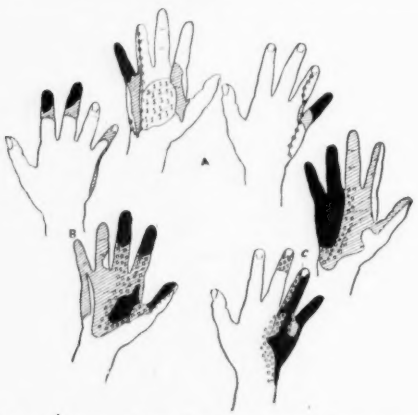

Fig. 9. Ulnar and median, postoperative recovery. A, Return of sensation in area between injured nerves; B, ulnar only neurolysis, median section; suture, return of pain, not cold; C, median only neurolysis, ulnar section and suture; patchy return of pain in ulnar. Black, loss of pain, touch, and temperature; shading, loss of touch; circles, loss of temperature; letter *S*, hypæsthesia; letter *X*, analgesia.

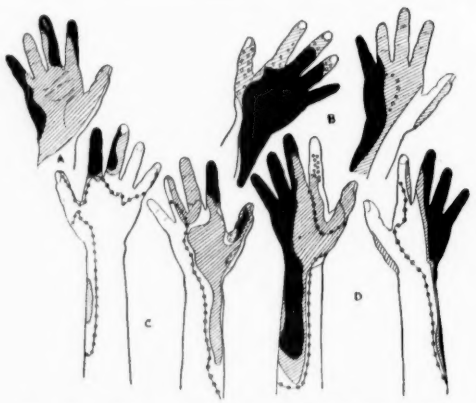

Fig. 10. Brachial plexus. A, Patch of return of pain in isolated supply; recovery between adjacent nerves; B, recovery of pain, not touch; C, recovery of touch, not cold; patchy return of touch; D, interlacing of loss of cold. Return of touch in isolated supply. Recovery of touch, not cold. Black, loss of pain, touch, and temperature; shading, loss of touch; circles, loss of temperature; letter *X*, analgesia.

Fig. 11.

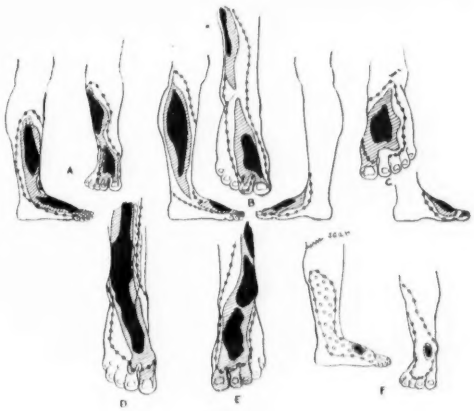

Fig. 12.

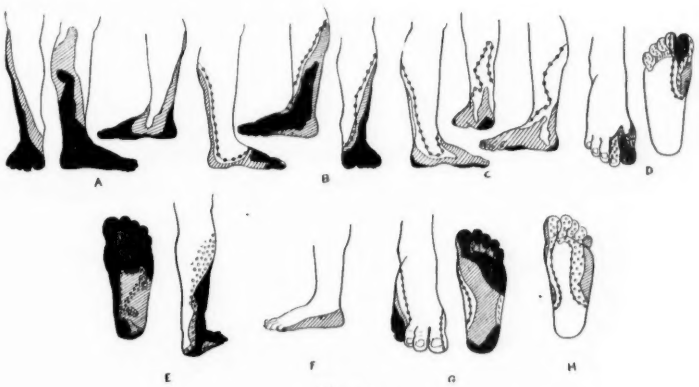

Fig. 13.

Fig. 11. External popliteal spontaneously recovering. A, Recovery of pain, interlacing of cold; B, recovery of pain; C, diminished area of loss of pain; D, recovery of touch and cold, not pain; E, recovery of touch, not pain. Black, loss of pain, touch, and temperature; shading, loss of touch; circles, loss of temperature; letter *S*, hypæsthesia; letter *X*, analgesia.

Fig. 12. External popliteal, postoperative. A, Patchy return of pain; B, patchy return of pain and touch, primary suture; C, return of touch in area of isolated supply; D, recovery of cold, great toe; interlacing; E, patchy return of pain; interlacing; F, recovery of touch, not cold. Black, loss of pain, touch, temperature; shading, of touch; circles, of temperature; letter *S*, hypæsthesia; letter *X*, analgesia.

Fig. 13. Sciatic spontaneously recovering. A, Extensive sensory loss marked motor recovery; B, recovery of pain internal popliteal with wide area of loss in external popliteal; C, recovery of touch, patchy; not cold; D, recovery of touch, not pain; interlacing of cold; E, recovery of pain in isolated supply; cold in patches; F, complete recovery external popliteal and of pain in internal popliteal; G, patchy recovery of pain in internal popliteal; recovery of external popliteal; H, recovery of touch and pain, not cold, patchy recovery of touch. The black area indicates loss of pain, touch, and temperature; shading, loss of touch; circles, loss of temperature; letter *S*, hypæsthesia; letter *X*, analgesia.

was well illustrated, as well as recovery to touch and not to cold and interlacing of borders of loss of cold (Fig. 10).

External popliteal nerve lesions spontaneously recovering, frequently showed complete recovery to pain. Interlacing of the border of loss of cold was seen, particularly over the dorsum of the foot. Areas of recovery to touch and not to pain or cold were occasionally observed. In the patients recovering following operation, loss of pain sense was more common. Here patchy return of pain sense

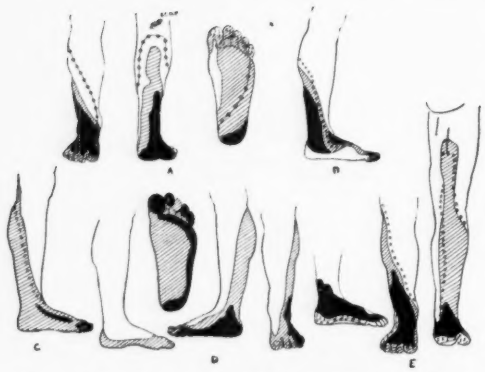

Fig. 14. Sciatic, postoperative. A, Recovery of pain and cold in area of internal popliteal; B, return of sensation in internal popliteal, patchy return of pain, interlacing of cold; C, marked return of pain; D, return of pain in external popliteal; patchy return in internal popliteal; cold not recorded; E, return of pain in internal popliteal; diminished loss of touch. Black, loss of pain, touch, and temperature; shading, loss of touch; circles, loss of temperature; letter *S*, hypæsthesia; letter *X*, analgesia.

was very frequently observed. Interlacing areas, recovery of touch and not of cold, as was the case in the radial nerve, were noted (Figs. 11 and 12).

Sciatic nerve lesions spontaneously recovering showed at times marked sensory loss with good motor recovery. Recovery of pain sense only in the area supplied either by the internal popliteal or external popliteal occurred frequently. Where sensation was returning to the sole, areas of recovery to touch and pain with loss to cold sense were seen. Areas of recovery to touch and not to cold were also observed over the leg. Where sensation had partly returned in the area supplied by the internal popliteal, the area of analgesia in the region supplied by the external popliteal occupied a wider area than is seen in isolated lesions of the external popliteal. Recovery by indentation and patches, both of touch and pain, occurred.

In patients recovering following operation, generally the loss of pain was more extensive. When partial recovery had taken place in the areas supplied by the internal popliteal, the sensory loss produced by the lesion of the external popliteal was very extensive. When one or other divisions of this nerve showed unequal regeneration, this condition was found to be the result of a lesser injury to the part first recovering (Figs. 13 and 14).

SUMMARY

The characteristic features of the sensory loss of regenerating nerves may be enumerated as follows:

Return of sensibility to pain, touch, or temperature sense in that area of the sensory distribution of a nerve which is supplied by it alone, i.e., the isolated sensory area of the nerve.

Return of sensibility to pain, touch, or temperature sense in patches some distance from the area supplied by an adjacent uninjured nerve.

Return of sensibility to pain, touch, or temperature sense in deep indentations.

Diminution of degree of loss of sensation of pain, touch, or temperature sense in the isolated sensory supply of a nerve.

Return of sensation of pain, touch, or temperature in the border between the sensory supply of two nerves simultaneously injured.

Interlacing of the border of sensory loss of one type of sensation with that of another.

CLINICAL AND EXPERIMENTAL STUDIES OF PULMONARY INFLAMMATION FOLLOWING INFLAMMATIONS OF THE BILE DUCTS AND GALL BLADDER

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IT has only lately been recognized that lung and bronchial inflammations very often follow biliary tract infections, although for some time it has been observed that both inflammatory processes may coexist. In such cases one usually finds that the primary disease is in the chest and that the biliary tract inflammation appears only as an accompaniment of the pneumonia, for it is already known that biliary tract infections may be caused by pneumonia.

How often the reverse of this holds true has only recently been recognized by Bahrdt, Wilkie, and others. From 1921 to 1924 we observed 7 cases, not only clinically but also experimentally, which showed this reversed course. Concerning the occurrence of pulmonary complications following biliary tract inflammations, little has heretofore been written. Mosse (1889), Sterne (1885), and Parissot (1905) showed that often the presence of cholelithiasis without marked symptoms is masked by the presence of the secondary pneumonia in the right lung. In 1905, Kehr noted that right sided pneumonia often appeared with gall-stone symptoms and disappeared immediately after operation. In 1913, Bahrdt wrote: "It is never difficult to diagnose cholangitis or cholecystitis if the symptoms are definite, but on the other hand, it is quite difficult if there is also present a pneumonia or bronchitis with high fever." Wilkie showed that biliary tract disease which gives no marked symptoms and which is accompanied by a severe pneumonia or bronchitis, is nearly always diagnosed only as the pulmonary disease.

CASE 1. —Y—, 28 years old, railway official, complained of marked epigastric pain. Previous history negative. On June 27, 1921, the patient suffered sudden severe epigastric pain associated with some nausea, but no vomiting or chills. The next morning the pains had decreased but the patient remained weak, had no appetite, and had a feeling of fullness in the epigastrium. Towards midday, the pain extended to the right hypochondrium, became more severe, radiated to the back and to the shoulder blade, and there appeared on the body a yellowish discoloration. The temperature was 38.3 degrees C. Patient was of medium height and had an expression of pain. The tongue was moist and coated; skin icteric. Pulse regular, 85 per minute; tension somewhat weak; respirations regular, 20 per minute; temperature 38.5 degrees C. Lungs and heart were negative; the liver was felt two fingerbreadths below the costal margin; under the liver one could feel the gall bladder, about the size of a hen's egg, very painful to pressure and evidently quite tense. The upper part of the right rectus abdominis muscle was rigid; stomach and intestines were negative. The urine was markedly yellow, Gmelin reaction positive; stools the usual color, a few ascaris eggs seen.

From the above findings we made the diagnosis of acute cholecystitis and treated the case accordingly. On the next day the hypochondrial pain extended over to the right side and the patient began to cough. At the right base râles were heard; temperature, respiration, and pulse as before. The gall bladder was still palpable and very tender. On the following day (July 1) the hypochondrial pain was somewhat less but still present on palpation. The cough had increased, râles were heard at both bases, and on percussion a muffled tympanitic note was obtained, vocal fremitus was increased. Temperature 38.8 degrees C., pulse 100, respiration 26. We made the diagnosis of a complicating acute pneumonia. On July 3, the pain in the epigastrium had decreased even upon pressure; the gall bladder and liver were hardly felt. At the lung bases there was dullness upon percussion, and many râles were heard; there was abundant sputum and considerable cough. On the seventh of July, the patient felt much better, the râles and dullness had decreased and there was no pain upon pressure in the gall-bladder region. The temperature and pulse were normal and there remained only a marked jaundice of the whole body.

In this case we felt that there was a causal relationship between the two conditions and that the pneumonia followed the acute cholecystitis, since in the beginning the biliary infection was the more marked, and also because while the cholecystitis was at its height the chest findings were negative and after the subsidence of the abdominal findings the pneumonia became so marked.

CASE 2. —T—, male, 28 years old, a merchant, complained of pain and a feeling of fullness in the epigastrium, especially after meals. Seven or 8 years earlier the patient complained of sudden, severe epigastric pain, chills, and high fever which kept him in bed for 2 weeks. He was unable to remember whether or not he was jaundiced at this time. Present illness began about the middle of January when he again suffered sudden, severe epigastric pains which now radiated toward the right chest and were accompanied by high fever and vomiting. For the next 2 months these recurred frequently, and after meals he noticed a dull pain in the epigastrium. During the time when he was free from pain, he had a feeling of fullness and pressure in the stomach region. Physical examination (April 10, 1921): Patient was of medium height, his skin was clear, pulse regular, temperature 36.5 degrees C. In the epigastrium, the edge of the liver was felt one finger-breadth below the costal margin. Under the liver edge and in the region of the lateral edge of the right rectus abdominis muscle, there was felt the distended gall bladder which was quite painful to pressure. X-ray examination of the stomach and intestines was negative. Blood, urine, stools, and gastric analyses were negative.

In this case we made the diagnosis of chronic cholecystitis and planned to operate on the eighteenth of April. On the preceding evening a cathartic was given to the patient and after taking it he complained of marked epigastric pain and severe chills. His temperature at the time was 39.2 degrees C. On the following morning his temperature fell to 37.2 degrees C. and the pains had decreased somewhat. He began to cough. There were dullness, many râles, and marked vocal fremitus at the right base. The patient's physician, who had treated him for a long time, stated that during his previous attacks these pneumonic symptoms often appeared and that it would be better to postpone this operation until the acute pulmonary signs decreased. We believed, however, that the pneumonia was secondary to the biliary infection and decided to operate under local anæsthesia. When the peritoneal cavity was opened the liver was found to be somewhat swollen, its surface a dark reddened color and its consistency somewhat firmer than normal. The gall bladder was a greenish white in color and was markedly adherent to the omentum and the duodenum. The common duct and the cystic duct were increased in size and their walls were thickened. No foreign bodies were felt; the stomach and intestines were normal. The gall bladder, after being removed, was found to be filled with thick, tenacious greenish yellow bile, in which were many small sand-like grains. For a few days after the operation there was considerable cough and hiccup, but on the ninth day postoperative all chest symptoms had disappeared, subjective as well as objective. The patient was discharged as well 4 weeks after operation.

This case seemed to show that the pneumonia or bronchitis occurring during an attack of cholecystitis may be alleviated or cured by removing the primary source of infection.

CASE 3. —K—, female, aged 37 years, housewife, complained of a feeling of fullness in the epigastrium. Previous history was negative. Present illness began in September, 1921, with sudden pains in the epigastrium which increased until February, 1922; there were also chills and loss of appetite. During the times when she was free from attacks, her appetite was very poor and the feeling of fullness in her stomach persisted. She was suspected of having a gastric ulcer and at another time was thought to be suffering from chronic bronchitis. Physical examination showed a small, poorly nourished woman, pale, and with an expression of pain; skin and mucous membranes anæmic; pulse 88 and regular; respirations 18, temperature 36.5 degrees C. The heart was normal; the lung-liver border was at the sixth rib on the right, the respiratory excursion was slight and at the right base there were dullness and crackling râles. The abdominal muscles on the right side were spastic, and there was marked pain upon pressure. On the left side the muscles were quite soft. Under ether anæsthesia an appendectomy was done. The appendix was free, but the liver was markedly swollen, increased in size, and came down about six fingerbreadths below the costal margin. The gall bladder was markedly enlarged and distended, the upper surface was a grayish white in color and adherent to the surrounding organs. The bile ducts were normal. The wall of the gall bladder, which was then removed, was very thick and the organ contained two stones, each about the size of a pea. Two weeks after the operation the patient was discharged as cured.

In this case we were able to recognize only at operation the biliary changes and at the same time to relieve the complications.

CASE 4. —M—, male, aged 54 years, gymnasium teacher, complained of attacks of fever and epigastric pain. He had beriberi at the age of 39. Present illness began in August, 1921, with sudden severe chills and fever of 40 degrees C. These symptoms would recur after exertion and would last 2 or 3 days. By February, 1922, attacks of fever became more frequent and he always had a feeling of fullness and dull pain in the epigastrium. Physical examination disclosed a large man, poorly nourished, with anxious facial expression, tongue coated, skin and mucous membranes anæmic but not icteric. Pulse regular, tension weak, 75 per minute; respiration 18; temperature 36.5 degrees C. Heart was enlarged but there were no murmurs. In the right lung base there were moist râles, but no dullness. In the epigastric region there was felt a mass about the size of a hen's egg, the upper surface of which felt hard and uneven. This mass was only slightly mobile and was very painful upon pressure. Under the right costal

margin there was a hard circumscribed area felt upon pressure. Liver, spleen, and kidneys were not palpable. Slight albuminurea; occult blood in the stools. The gastric analysis showed a total acidity of 16 and no free acid. Hæmoglobin 38 per cent (Sahli). A diagnosis of carcinoma of the stomach was made. While in the hospital the patient had another attack of fever (40 degrees C.), with severe chills, and in both bases, but more especially the right, many moist râles were heard. Six days later the chest symptoms had cleared up and the patient was operated upon. Besides the tumor of the stomach was found also a greatly enlarged gall bladder with markedly swollen lymph nodes at its duct end. The gall bladder and the tumor of the stomach were removed and a Billroth II operation was done. Postoperatively the pains in the stomach, the attacks of fever, and the chest symptoms all disappeared, but on account of increasing weakness and loss of appetite the patient died 4 weeks later.

This case showed us that besides the stomach carcinoma, a chronic cholecystitis which caused the fever and pulmonary symptoms was also present although unknown.

CASE 5. —T—, male, aged 47 years, restaurant keeper, complained of epigastric pain, cough, and sputum. Since the age of 20 he has used alcohol habitually. His present illness began 2 years ago when he noticed a feeling of fullness and pressure in the epigastrium. Suddenly, in January, 1928, he was seized with an attack of vomiting and severe pain; this was after some excess in drinking. The pain was most severe immediately after meals; this condition persisted for 4 months, during which time his skin became jaundiced and he had a productive cough. He became markedly constipated, sometimes going 4 or 5 days without a bowel movement. His appetite became very poor and he lost weight. He was thought by one physician to have carcinoma of the stomach and by another to have chronic bronchitis. Physical examination disclosed a man of medium stature, poorly nourished, tongue coated, skin and mucous membranes anæmic but not icteric. Pulse normal, temperature 36.7 degrees C. Over both lungs, anteriorly as well as posteriorly, were heard many moist râles, especially at the right base. In the epigastrium and extending into the right hypochondrium there was found upon pressure a resistant mass. The liver, kidneys, and spleen were not felt. Gastric analysis revealed a total acidity of 5, no free hydrochloric, and no lactic acid. X-ray examinations showed that there was some gastroptosis and an increase in the mediastinal shadow, due to an increase in the peribronchial and hilus lymph nodes. The movement of the right side of the diaphragm upon deep inspiration was much less than normal. The sputum was thick and tenacious, a grayish-white in color, containing greenish areas; microscopically it showed many cocci and diplococci. Inasmuch as the pulmonary symptoms were quite stubborn, and since the patient was suspected of harboring a carcinoma of the stomach, it was decided to operate and not wait until the chest findings cleared up. The operation was performed under local anæsthesia. The stomach was found to be greatly distended, but otherwise negative. The gall bladder was atrophic and its walls greatlythickened; its anterior surface was adherent to the stomach and the omentum. The gall bladder was freed of the adhesions and then massaged. After the operation the pulmonary signs gradually disappeared and the patient was discharged 4 weeks after operation as cured. Three months later we heard that the cough and sputum had returned, but he was free from the epigastric pains.

In this case it was only at operation that the chronic cholecystitis and pericholecystitis were recognized, and we feel that if we had removed the gall bladder instead of only severing the adhesions, the cough and sputum would have been cured permanently as was the epigastric pain.

CASE 6. —Y—, female, aged 50 years, housewife, complained of jaundice and itching. Previous history was negative. Present illness began November, 1921, when she noticed a dull pain in the right hypochondrium which was many times accompanied by chills. During a marked attack this pain radiated to the left chest and to the region of the shoulder and the temperature rose to 39 degrees C.; in addition there was marked jaundice of the skin and a feeling of itching. Physical examination disclosed a woman of medium stature, poorly nourished, tongue coated, skin and mucous membranes greatly jaundiced. On the back, over her body, there were several hæmorrhagic areas about the size of a pea. Pulse 125, respiration normal, temperature 37.2 degrees C. There was a systolic murmur at the apex. Upon percussion the lungs were negative, but upon auscultation many dry and moist râles were heard. The liver was enlarged and came down 1 fingerbreadth below the costal margin; its upper surface was smooth and somewhat painful. To the right of the epigastrium there was some muscle spasm. In the urine there was strong bile pigmentation; the stools were clay colored. The sublimate test of Schmidt was markedly positive, as was also the test for occult blood. During the course of the 2 weeks' observation in our clinic there was considerable cough and fever, physical signs were always present in the chest: the patient refused operation.

In this case the extensive jaundice and the hæmorrhagic diathesis were the result of occlusion of the biliary ducts. One can also assume safely that the bronchitis and the endocarditis were also the result of this biliary occlusion, since no other possibility was present.

CASE 7. Male, aged 49 years, school teacher, complained of epigastric pain after meals. Previous history was negative. About 10 years ago the patient had sudden severe pains in the right hypochondrium, accompanied by chills. Two years ago there was another similar attack and, in addition, fever and vomiting. During the periods when he was free from pain he noticed loss of appetite, weakness, and abundant cough; jaundice was also sometimes noticed. Since March, 1923, the pain had been present after meals. Physical examination showed the skin and mucous membranes jaundiced and somewhat anæmic. Pulse was normal, temperature 36.9 degrees C. At the back on both sides dry and moist râles were heard and the breath sounds on the right were in general weaker than those on the left. Upon pressure the patient complained of pain under the right costal margin; liver and gall bladder were not felt. The gastric contents were neutral. The urine gave a strongly positive test for bile pigment; stools were normal. By means of the duodenal tube we were unable to withdraw more than 15 cubic centimeters of clear yellow bile, even after the addition of magnesium sulphate. The liver function test of Widal was positive. A diagnosis of cholelithiasis and cholecystitis was made, and on June 5, 1923, the patient was operated upon under local and paravertebral anæsthesia. The stomach and intestines were normal; the gall bladder was grayish white and the walls were thickened and hard, as were also the bile ducts. The common duct was enlarged to the size of one's thumb and contained three polygonal stones. Cholecystectomy was done; the common duct was opened and the stones removed. The patient had an uneventful recovery.

In this patient the epigastric pain, cough, and sputum were present in the beginning, and he was suspected of having a carcinoma of the stomach for a long time. From the previous cases we felt that this was one of biliary inflammation and this was shown to be the case at operation.

Of the above 7 cases, the first showed acute cholangitis which was the cause of the secondary pulmonary symptoms. In the other cases the cholecystitis or cholangitis was the primary disease process, although in comparison with the secondary pulmonary symptoms, the presence of biliary disease was hard to recognize. The sixth case was one of occlusion of the common duct through which a bilateral bronchitis was brought about.

Much has heretofore been written about the coincidence of cholangitis or cholecystitis with pneumonia and bronchitis, but all the reports deal with those cases in which the pneumonia brought about the biliary infections and not the opposite as we here describe. Wilkie alone has described 23 cases of primary acute cholangitis of which 12 developed secondary lung complications. Of 25 acute or chronic cases of cholangitis which we have observed, 7, or 28 per cent, developed similar lung conditions; consequently, we might state from our experience that one should give more thought to this complication as it is present more often than has been assumed.

In biliary inflammations it is of great help to examine the respiratory movements on the right side by means of the X-ray, as much for the diagnostic purpose as to explain the etiology. Schuhlmeyer (1905), in investigating the relation of gall stones, acute jaundice, and liver swelling, and later Westphal, in studying the incidence of gall-stone colic, both noticed the significant decrease in the movement of the diaphragm on the right side. Wilkie states: "The decreased respiratory movement of the right side of the diaphragm in cases of acute biliary inflammations is caused by the abnormal stimulus to the nerve centers on this affected side, and that due to this diaphragmatic weakening, atelectasis and hyperæmia appear, which induce the inflammatory changes in the right lung." We have studied the respiratory movements in patients suffering from biliary affections, both during the time of an attack and in the time when they were free from pain, and have compared these with the normal.

The respiratory movement of the diaphragm is not easily measured by the X-ray because it depends on various factors difficult to control. We followed the method described by Schuhlmeyer, the displacement of the peak of the diaphragm by deep respirations. The results are embodied in Table I.

TABLE I

Sex	No. of cases	Ages	Excursion of the halves of the diaphragm	
			Right side cm.	Left side cm.
Male	22	20–39	2.5–6.0	2.0–6.0
Female	22	17–41	2.0–5.0	1.2–4.5

Therefore, in healthy men the average is 3.97 centimeters on the right side and 3.94

centimeters on the left side, and in healthy women the average is 3.54 centimeters on the right and 3.34 centimeters on the left.

TABLE II

Sex	No. of cases	Diagnosis	Excursion of the halves of the diaphragm	
			Right side cm.	Left side cm.
Male	8	Cholecystitis Cholelithiasis Common duct occlusion	0.3–4.0	1.8–3.0
Female	7	Cholecystitis Cholelithiasis	1.2–3.0	2.2–3.5
Average-Male			1.42	2.01
Average-Female			2.16	2.68

In Table II are recorded similar determinations upon patients with biliary affections, but during the periods when they were free from attacks. The average excursion in the men was 1.47 centimeters and in the women 2.16 centimeters.

TABLE III

Sex	No. of cases	Diagnosis	Excursion of the halves of the diaphragm	
			Right side cm.	Left side cm.
Male	3	Cholecystitis Cholelithiasis	0.2–1.0	0.9–2.5
Female	2	Cholecystitis Cholelithiasis	0.5–1.5	2.0–2.3
Average-Male			0.57	1.46
Average-Female			1.0	2.15

In Table III are similar determinations in patients during an attack, the average excursion in man is 0.5 centimeter and in women is 1 centimeter.

From the tables we can see, therefore, how great is the difference between the normal and the diseased, especially in an acute attack. Westphal and Wilkie explain this difference by the fact that during an attack of colic the nerves of the right side of the diaphragm are abnormally stimulated. Our conclusions, however, did not agree with this, since this difference is present, not only during an attack of colic, but also when the patient is free from an attack, as shown in Table II. From our observations, we believe that the decrease in excursion of the diaphragm is due mainly to adhesions, especially during the periods of freedom from pain, and the more extensive is this scarring at the site of disease, the more significant is this change.

CONCLUSIONS

1. From the present observations it is noteworthy how often one meets with pneumonia and bronchitis which is brought about by biliary inflammation.

2. It can no longer be said that the cause of the disease lies in the chest when the pneumonia is associated with jaundice or other evidence of biliary inflammation.

3. When the cause of the pneumonia and bronchitis is not clear, it is important to consider these obscure bile duct affections which may be responsible. Likewise, through the chest findings one may discover bile-duct disease which was hard to recognize.

4. Study of the movement of the right side of the diaphragm in these cases is of diagnostic importance and also gives an idea of the degree of cicatrization, because this respiratory movement depends upon the amount of scarring or adhesions.

5. General anæsthesia might be contraindicated in cases of this type and one will obtain better results by operating under a local anæsthetic whereby the chest complications are not aggravated.

EXPERIMENTAL STUDIES OF LUNG AND BRONCHIAL INFLAMMATIONS SECONDARY TO BILE-DUCT AND GALL-BLADDER INFLAMMATIONS

The purpose of this second part of our contribution is to answer the questions as to how the pneumonia is caused in individuals who have biliary infections. In 1903, Kayser and Brion performed experiments in which they injected pneumococci into the gall bladder of a dog for the purpose of producing this complication, but they reported no positive results. On account of these negative results, and despite the efforts of other investigators, such as Bahrdt, Kehr, and Wilkie, this question has been neglected. We have tried to

repeat the experiments of Kayser and Brion to determine the course that the inflammatory process takes from the biliary system to the lung and to determine whether the decrease in the diaphragmatic excursion is a factor predisposing to the production of the pulmonary inflammation. We used dogs which had been starved for the previous 24 hours. These were given a hypodermic injection of 1 per cent morphine hydrochloride in the proportion of 1 cubic centimeter per kilogram of body weight. The operative procedures were carried out under strict asepsis. The above workers used pneumococci isolated from the sputum of a case of pneumonia, but we used the following organisms: pneumococci isolated from the pus of a case of pyopneumothorax; one strain was of strong virulence, 1 cubic centimeter of a 24 hour broth culture killing a mouse in 12 hours after intraperitoneal injection; another was of much weaker virulence and similarly killed a mouse in 4 or 5 days. A strain of staphylococcus was also used, the virulence of which was very marked. Under the influence of morphia, and sometimes with the addition of chloroform, the abdomen of the experimental animal was opened in the midline and the common duct was tied off with silk. The gall bladder was then injected with the boullion cultures of the above bacteria, in the ratio of 0.5 cubic centimeter per kilogram of body weight. Care was taken in making this injection and the puncture hole through the sero-muscular coat of the gall bladder was closed with a purse string suture of very fine silk. The region of the puncture hole was sponged with gauze which had been dipped in bichloride solution. The abdominal cavity was then closed in interrupted layers and the skin wound treated with collodion.

Autopsy was carried out as soon as possible after death. In order to retain as much as possible the air and blood contents of the lungs, as soon as the thorax was opened the bronchi and blood vessels to the lungs were clamped. Bacteriological examinations of the heart blood and gall-bladder contents were made on agar and broth cultures: for histological examination pieces of both lower lobes were fixed in Zenker's fluid, imbedded in paraffin or celloidin, and stained with hæmatoxylin and eosin. The gall bladder and a piece of liver were prepared in the same way. Demonstration of bacteria in the gall bladder and lungs was done by means of the Weigert and MacCallum staining methods.

Experiment 1. Dog, weight 11.6 kilograms; injected with a virulent culture of pneumococci. Chief finding after 3 days was acute cholecystitis.

Experiment 2. Dog, weight 9.9 kilograms; injected with a virulent strain of pneumococci. Autopsy findings after 4 days showed the liver to be swollen, dark red in color, and the individual lobes adherent to the gall bladder. The upper surface of the liver was raw and velvety in appearance; the gall bladder was covered by the liver, its walls were grayish white in color, except for occasional dark red hæmorrhagic areas. The content of the gall bladder was a cloudy mucoid greenish bile; the common and cystic ducts were about twice the usual size. In the lungs there were occasional dark red areas of hæmorrhage, especially in the left upper lobe. The lungs were firm in consistency and upon section contained an increased amount of blood. Histologically the walls of the lung alveoli were destroyed and throughout the tissue there were hyperæmia and bleeding. From the heart blood pneumococci were isolated; from the gall bladder colon bacilli; and from the lungs pneumococci. The chief findings were pericholecystitis, perihepatitis, and acute hæmorrhagic pneumonia.

Experiment 3. Dog, weight 8.8 kilograms; injected with staphylococci. Autopsy 2 days later. In the peritoneal cavity there was a small amount of bloody fluid. The liver was adherent to the stomach, intestines, mesentery, and omentum; it had a dark brown color, was hyperæmic and enlarged. It was firm in its consistency and on its upper surface there was a fibrinous exudate which was adherent also to the diaphragm. The scarred gall bladder, which was covered by the liver lobes, contained a bloody, purulent material. In the right pleural cavity there was a small amount of bloody exudate, and the right lung had a very dark red color. The left lung was increased in size, was emphysematous, and showed a normal pinkish color upon which were dark red areas of bleeding. The cut surface of the right lung was full of fluid and contained very little air; the left lung contained a large amount of air. Histologically there were hyperæmia, hæmorrhage, and round cell infiltration in the lung, and the alveoli and bronchi contained a mass of cells. Staphylococci were demonstrated in the lung and were isolated from the heart blood and from the gall bladder. The chief findings were acute purulent cholecystitis, peritonitis, and acute pneumonia of the right lung.

Experiment 4. Dog, weight 8.5 kilograms; injected with a virulent strain of pneumococci. The chief finding after 3 days was cholecystitis.

Experiment 5. Dog, weight 4.7 kilograms; injected with a weak strain of pneumococci. The chief finding after 3 days was cholecystitis.

Experiment 6. Dog, weight 3.9 kilograms; otherwise the same as the previous experiment.

Of these 6 experiments we were able to verify acute pneumonias in the second and third, which in the second was caused by a virulent pneumococci and in the third by staphylococci. Pneumonia may be produced by experimental cholecystitis if the bacteria are virulent enough.

It now remained to determine the path that the infecting organism took. Two explanations have previously been mentioned, that of Kelling and Kehr, that the inflammatory process spreads directly through the diaphragm into the lung; the second explanation, that of Bahrdt and Wilkie, that it enters the lung indirectly through the lymph or blood streams. In determining which of these routes prevailed we used dogs and rabbits. The common duct was tied off and the gall bladder injected in each case with staphylococci. Within 3 days we sought for the bacteria in the heart blood and in the tissues of the diaphragm. In all, 17 such experiments were done, 6 on dogs and 11 on rabbits. In 6 instances (4 rabbits, 2 dogs) the bacteria were isolated from the heart blood; in 5 cases (3 rabbits, 2 dogs) the bacteria were isolated from the right side of the diaphragm. In most of the cases the bacteria were found in the region of the gall bladder. In 2 rabbits there was an acute pneumonia and in 1 dog there was hyperæmia of a lung. From this we concluded that there are two paths whereby the inflammation may pass from the gall bladder into the lung, a direct and an indirect one, and that one meets with this complication more often when the biliary ducts are obstructed.

In the clinical cases we observed the definite decrease of the diaphragmatic excursion on the right side in patients suffering from biliary affections. In order to show whether this condition predisposes to the occurrence of pneumonia, we cut one of the phrenic nerves in an attempt to simulate conditions as seen clinically. We followed 4 different procedures as follows: in 2 animals, simple laparotomy; in 8 animals, section of a phrenic nerve; in 3 animals, laparotomy plus section of a phrenic nerve; in 2 animals, injection of bacteria into the gall bladder after section of a phrenic nerve, but without tying off the common duct.

The results of these experiments showed more or less atalectasis and hyperæmia but no inflammation in the lung. In the fourth group we were unable to recover bacteria from the heart blood and there was no marked cholecystitis. The paralysis of the diaphragm seemed to have no great influence on the production of pneumonia. Finally, in a fifth group of 18 experiments, we repeated what was done in the fourth group, but this time also tied off the common duct. In all of these 18 animals we produced a severe cholecystitis, in 5 cases accompanied by acute pneumonia (3 rabbits, 2 dogs). In these 5 cases there was also marked pericholecystitis and we were able to recover the bacteria from the heart blood and the lung tissues. This significantly showed that the essential cause of this pneumonia was not due to paralysis of the diaphragm but due to the bacteria entering the lungs from the gall bladder. It goes without saying that this complication is more prevalent when the bile duct is obstructed, as with a stone, or when the inflammatory process is so severe that the bacteria extend through the gall-bladder wall and affect the surrounding tissue.

CONCLUSIONS

1. It is possible to produce pneumonia experimentally following an acute cholecystitis, but the common duct must be tied off and the virulence of the bacteria must be severe.

2. There are two paths through which the bacteria can go from the gall bladder to the lung: (a) Directly through the diaphragm into the right lung; (b) indirectly through the circulation into both lungs. Therefore, one sees much more right-sided pneumonia clinically.

3. The decrease of diaphragmatic excursion on the right side in patients suffering from biliary affections has no great influence upon the origin of the right-sided pneumonia.

4. The essential cause of this pneumonia lies in the fact that the bacteria enter the lung tissue from the biliary system, hence, this complication is much more frequent when the common duct is obstructed or when the inflammatory process is very marked.

END-RESULTS OF TRANSPLANTATION OF THE URETER[1]

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A REVIEW of the literature shows that the results of implantation of the ureter are successful in the hands of comparatively few surgeons. The technique of this operation has been well described by Charles Mayo, Coffey, Lower, Franklin Martin, Styles, Fowler, Peters, and others, while the pathology, bacteriology, and kidney functions have received little attention.

Much credit is due Franklin Martin for work done as early as 1898. Martin implanted the ureter in the rectum in 37 dogs and 3 human beings. Of the dogs, 4 lived for an indefinite period, 2 having both ureters implanted in the rectum. Of the humans, 1 patient, in whom the ureter was implanted following removal of the bladder, lived 3 years. In a second, the operation was performed for exstrophy of the bladder and was only a partial success. One dog with a double implantation later died of an intercurrent infection and an autopsy examination was made by F. R. Zeit. The right kidney showed a suppurative nephritis. The left kidney was almost normal except that one portion had a nodular appearance similar to the granular kidney of chronic interstitial nephritis. The capsule was slightly adherent over this portion. The bladder was moderately distended with a semipurulent fluid which escaped from the urethra when pressure was exerted. Had Martin used rubber tubes or ureteral catheters in his operation it would have revolutionized this work at an earlier date. We believe the rectum is not as satisfactory a field for implantation as is the large bowel higher up.

The work of Martin was followed by that of Peters, who made an excellent contribution in 1901 on results obtained with a technique very similar to that of Martin.

Inasmuch as the consensus among surgeons favors the nonoperative treatment for bladder cancer, I am of the opinion that ureteral implantation is destined to become more popular in early cancer cases in the future than it has been in the past.

I agree with Coffey that this operation should not be used in the late cancer stage because metastasis, hydro-ureter, and poor kidney function are likely to follow.

While this is only a preliminary report I believe that before the operation is more extensively used there should be greater familiarity with the functional, bacteriological, and pathological results of the operation. If the surgeons doing the operation would devote less time to reporting the technical details, which are sufficiently well known, and devote more time to extending our knowledge by their observations regarding functional, bacteriological, and pathological details, I think the value of ureteral implantation would be greatly enhanced. Therefore, it seemed desirable to try to learn from experiments what the results are as to kidney function, pathology, and bacteriology following ureteral implantation. For this purpose we have operated on 14 dogs and 1 human being, using the Coffey technique.

The work of ureteral implantation was started in October, 1925. Of the first 5 dogs operated on 4 died. At autopsy the same pathological condition was found in each dog. Death was not due to the Coffey technique but to our failure to draw the ureter far enough into the lumen of the bowel and to the fact that there was too much tension on the ureter, the result being a suppuration at the site of implantation into the bowel and, hence, an ascending infection into the kidney producing an acute pyelitis and general peritonitis. Perfecting the technique by taking away all tension from the ureter after implantation, and introducing the ureter far enough into the bowel we secured better results, and we found that the urine emptied freely into the lumen of the bowel. In these experiments the dogs made a good recovery from the operation and were allowed to go on to complete convalescence. Later, they were studied for function and bacteriology, and finally, pathology.

[1]Read before the American College of Surgeons, Boston, Massachusetts, October, 1928.

We are reporting only the results of single implantations for the reason that in these dogs the normal side was used for a control. My only regret is that we have not more dogs to report at this time. At the present time we have 5 dogs living. Our observations on the results of implantation in these dogs will be reported at a later period.

Dog 1. Small, yellow, young male dog, was given ether anæsthesia on November 10, 1925, and the following operation performed: A low right rectus incision was made, the rectus muscle being displaced medially. The ureter was raised with forceps and stripped of its peritoneal covering for a distance of about 3 inches. A small incision was then made into the lumen of the ureter and a probe passed both proximally and distally. The ureter was then dropped back into position, no attempt being made to close the opening in the ureter or to peritonize it. The reason for so doing was to determine whether a wound in a ureter will close spontaneously or if peritonitis will develop from leakage of urine. The peritoneum was closed with No. 1 catgut, the muscles with continuous chromic catgut, the fascia with No. 1 catgut, and the skin with interrupted sutures. Collodion dressing was applied.

On November 21, 1925, 11 days after the operation, the dog was apparently in good condition. On December 2, 1926, the dog died. The autopsy findings were as follows:

Marked confluent, suppurative bronchopneumonia and bilateral sanguino-purulent pleuritis. The peritoneal cavity, especially the pelvis, was discolored, being dark gray to black. There was no fluid present. There were no adhesions. The retroperitoneal fat was necrotic. A soft, fluctuating tumor mass about the size of an almond was found adjacent to the left wall of the bladder. The right kidney was larger than the left and its upper pole was streaked with grayish-yellow streaks radiating outward from the medulla. At the periphery these streaks looked like depressed spots beneath the capsule. No fluid or pus could be expressed from these areas. There was no evidence of infection of the pelvis or ureter but there was a patch of submucous ecchymosis in the bladder above the opening of the right ureter. The bladder was contracted but its walls were otherwise normal. Attached to the left wall of the bladder was an oval, fluctuant mass about 2.75 centimeters long by 1.5 centimeters in diameter. This was a smooth walled cyst filled with a partly clotted hæmorrhagic fluid. The lining of the cyst was roughened at its point of attachment to the bladder but there was no communication between the two. The opening in the ureter was patent and opened into retroperitoneal tissue. As nearly as one could tell, the peritoneum covering it was intact.

Microscopic examination of kidney tissue revealed a slight ascending urinary infection with cloudy swelling of the left kidney. The right kidney showed a marked ascending urinary infection with many small cortical abscesses.

Dog 2. Large, brown male dog, anæsthetized with ether and operated upon November 17, 1925. Low right rectus incision made. Right ureter was isolated and freed from peritoneum over a distance of about 5 inches. The ureter was ligated about 2 inches above its distal extremity and was cut above the ligature. A catheter was then passed into the ureter and held in place by means of a catgut ligature. An incision was made longitudinally in the distal portion of the sigmoid. A rectal tube was passed. The catheter was introduced through the incision in the sigmoid into the rectal tube and drawn out through the anus. The rectal tube was then withdrawn. The serosa and muscularis were sutured over the ureter at the point of incision in the sigmoid. At this point the dog died from ether asphyxia.

Dog 3. Large, brown male Airedale was given an ether anæsthetic on November 20, 1925, and a lower left rectus incision was made. The left ureter was isolated and implanted into the sigmoid, the technique described under Dog 2 being used. This dog died November 24, 1925, and autopsy revealed a huge phlegmonous gangrene of the abdominal wall about the incision. There were many abscesses about the incision in the sigmoid and loops of small bowel were also markedly adherent in this neighborhood. There was much free pus in the peritoneal cavity. The ureter came away easily. The catheter was not found in the rectum.

Diagnosis: leakage about ureteral implant and generalized peritonitis.

Dog 4. Large, white male with grayish black spots was given ether anæsthesia and operated upon November 24, 1925. The technique used in this operation was the same as that used in Dog 2, except that both ureters were implanted into the sigmoid, one on the right side and one on the left side of the bowel, the ureter implanted on the right side being placed at a slightly lower level than the one on the left. During the operation it was noticed that the flow of urine from the left ureter was less free than it was from the right. This was probably due to the ligature about the left ureter being tied too tightly.

This dog died November 27, 1925. Autopsy revealed a general peritonitis and necrosis of the ureters about their point of entrance into the bowel.

Dog 5. Large, long haired, brown and white male was operated upon November 27, 1925. The same technique was used in this operation as in those previously described; only the right ureter was implanted. On November 30, 1925, the dog was apparently in good condition. It continued to progress and finally made a complete recovery, so that on November 4, 1926, the dog was apparently well and running at large in the big pen.

On December 10, 1926, the dog was again anæsthetized, the left ureter isolated and implanted into the sigmoid as previously described. The dog died on December 20, 1926. Autopsy showed the incision

gaping and sloughing, with much purulent discharge. Peritoneum was adherent to the right side of the bladder and sigmoid. Pelvic peritoneum was injected and dulled with fibrin.

The right kidney was about half the size of the left which was about normal. There was fibrous perinephritis at both poles of the kidney. Both poles were quite markedly scarred and pitted. The cortex was thin and markings were destroyed. The pelvis and proximal portion of ureter were dilated and thickened, the mucosa was injected and roughened. The ureter was anastomosed to the sigmoid 10 centimeters above the anus. There were a few omental adhesions about the anastomosis. The peritoneum was continuous from the ureter onto the bowel. The ureter passed between serosa and mucosa for 22 millimeters and then opened through an opening which admitted a fine probe. The mucosa about the opening was smooth and there were no ulcerations.

The left kidney was of normal size. The pelvis and entire ureter were dilated; mucosa studded with petechial hæmorrhages. Ureter entered sigmoid 7.5 centimeters from anus. This ureter passed below mucosa for about 2 centimeters. Over it the mucosa was smooth. There was a distinct obstruction about the middle of the submucous portion and only a very small probe could be passed.

Anatomic diagnosis: chronic right hydronephrosis; ascending urinary infection with atrophy and scarring; acute left ureteral obstruction.

Dog 6. Medium sized white, short haired male, operated upon December 7, 1925. The left ureter was isolated and implanted into the sigmoid by the same technique as previously described. In this operation the sigmoid was fastened to the lateral pelvic wall by one catgut stitch.

On January 4, 1926, the dog was in good condition and continued to progress throughout the next year. On February 7, 1927, 1 year and 2 months after the first operation, the dog was again anæsthetized and a midline incision made. The left ureter was isolated, then incised, and a ureteral catheter inserted. There were a few adhesions about the site of anastomosis but these were not marked. The right ureter was also isolated, incised, and a catheter inserted. A kidney function test was done, 1 cubic centimeter of phenolsulphonephthalein being used, with the following results: From the right kidney dye appeared in 3 minutes in good concentration. From the left kidney dye appeared in 3½ minutes in good concentration. The dye showed 25 per cent on each side in 15 minutes.

The dog was killed with ether. Autopsy showed the right kidney entirely normal. The left kidney was smaller than the right and was scarred at both poles; the capsule was scarred and thickened at poles. The pelvis and ureter were of normal size. The anastomosis was well healed with some thickening of the left ureteral wall in the distal third. The opening of distal portion of the left ureter into the bladder was not found.

Dog 7. Small, brown male operated upon December 15, 1925. Operation consisted in anastomosing the left ureter to the sigmoid, the technique previously described being used. This dog made a complete reovery and 2 years later (February 1, 1927) was again anæsthetized, the ureters isolated, incised, and catheterized. Urine was collected for culture. Functional test showed the appearance of the dye within 3 minutes from each kidney. The dye was in good concentration. In 15 minutes the dye showed 22 per cent on the left side and 24 per cent on the right side.

The dog was killed with ether. Autopsy revealed the anastomosis well healed and the left kidney of normal size. There was very slight scarring of the capsule. The right kidney was enlarged, the ureter thickened, and marked hydronephrosis was present. No scars were present. The ureter was patent and a probe could be passed from the ureter into the bladder.

There is no explanation for the hydronephrosis on the unanastomosed side unless pelvic infection secondary to operation caused a peritonitis.

Dogs 8, 9, and 10 were operated upon December 9, 11, and 13 respectively, 1925, the Coffey technique as previously described being used.

On February 8, 1927, 1 year and 2 months after operation, these dogs were anæsthetized in the same manner as were Dogs 5, 6, and 7. The right ureter, which had been implanted in the previous operation, was isolated and a double ureteral catheterization was done by making a small slit in each ureter. A kidney function test was done, 1 cubic centimeter of phenolsulphonephthalein being used with the following results:

In Dog 8 the dye appeared on the good side in 3½ minutes and on the right or implanted side in 4 minutes. The function on the left side was 22 per cent in 15 minutes, while on the right it was 18 per cent. Bacteriology was negative on both sides.

In Dog 9 the dye appeared on the left side in 3½ minutes and on the right or implanted side in 4½ minutes. Function was equal on both sides—21 per cent in 15 minutes. The urine was negative on both sides.

In Dog 10 the right ureter was found to be slightly larger than the left. The right was the implanted side. In the dye test the dye appeared on the left side in 3½ minutes and on the right side in 6 minutes. Laboratory analysis showed colon bacillus in the urine from the implanted side and sterile urine on the left side. The pathology will be shown in the accompanying slides.

In this case the implant was made into the bladder instead of into the bowel. Hydro-ureter and hydronephrosis were marked, especially the hydro-ureter. This was due to a constriction of the ureter at the place where the implantation into the bladder was made. We tried to use the technique as in the bowel but apparently the bladder does not work with the same valve-like mechanism. In other cases, in which we made an implantation into the bladder, we found

Fig. 1. Bowel ready before double transplant.

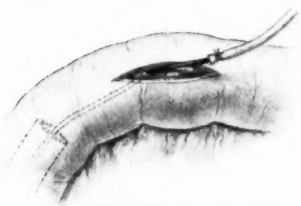

Fig. 2. Introduction of ureter in single transplant.

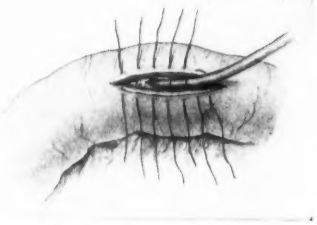

Fig. 3. Method of suturing after introduction of ureter.

we were apt to get a hydro-ureter, which proves pretty conclusively that the Coffey technique of transplantation in the bowel is the operation of choice.

The advisability of implanting the ureter into the bladder with a resultant hydro-ureter is very well shown in the operation on the human. In this patient the ureter had been severed and it had anastomosed to the cutoff cervix following a hysterectomy; at the point of anastomosis the ureter due to constriction was about the size of a large cambric needle. The remaining portion of the ureter was a true hydro-ureter. This demonstrates clearly that the technique used in the bowel implant is the correct one.

The patient on whom this operation was performed presented the following history:

Fig. 4. Suture holding bowel in place to relieve tension on ureter.

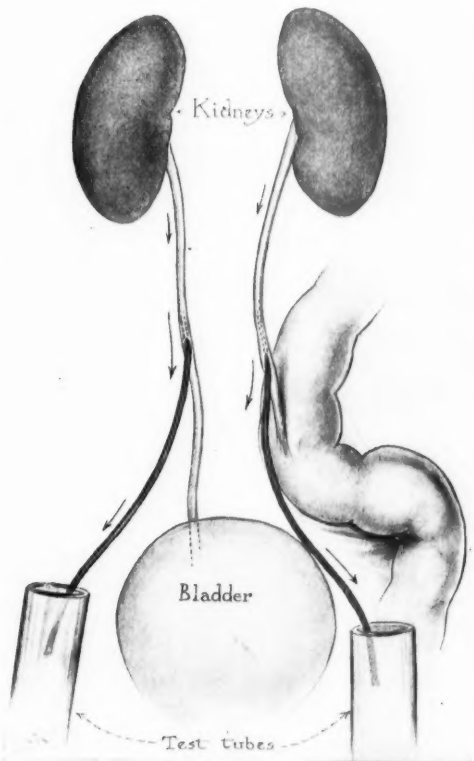

Fig. 5. Technique of doing function test and collecting urine.

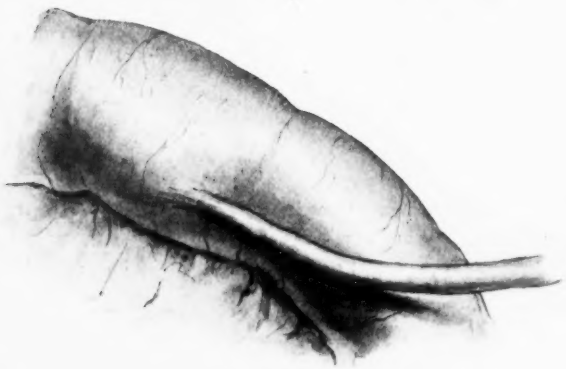

Fig. 6. Operation completed.

Mrs. H., aged 41 years, entered the hospital on December 27, 1926, complaining of incontinence of urine and dribbling. She had been operated on 6 months previously for fibroid of the uterus. Twelve days after operation she noticed the incontinence and loss of bladder control.

Physical examination was essentially negative except for the bladder condition. Further examination showed that part of the urine was coming from the vagina while the rest came through the natural channel.

Cystoscopic examination was made. The right ureter was catheterized without difficulty. On the left side the catheter met an obstruction about 6 centimeters above the ureteral orifice. A normal flow of urine was obtained from the right side but no urine from the left. Indigocarmin was injected intravenously. The blue color could be seen coming very rapidly from the right side but nothing came from the left side. By means of a vaginal speculum the blue urine could be seen coming from the cervix. The patient was kept under observation for 4 days and no further information elicited. It was evident that she had a fistula of the left ureter but it was impossible to tell how high up in the ureter it was located.

Fig. 7. Relative size of dog bladder.

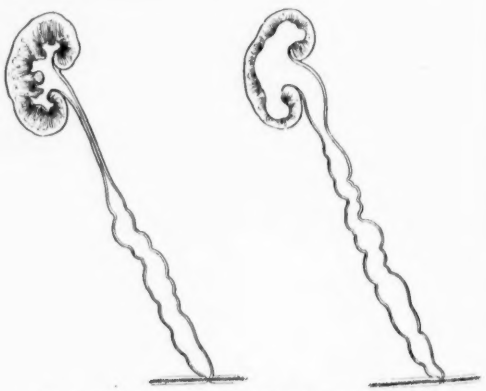

Fig. 8, left. Hydro-ureter with a direct implant.

Fig. 9. A hydro-ureter and hydronephrosis with a direct implant. Much care should be observed in following the Coffey technique so as to avoid the above condition.

Fig. 10. Medium power section from parenchyma about 2½ centimeters from kidney pelvis.

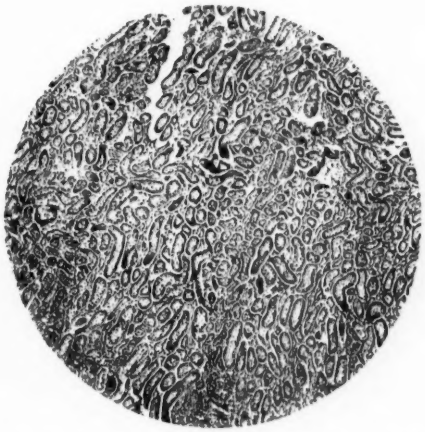

Fig. 11. Low power section in same position as in Figure 10.

Fig. 12. Medium power. Transverse section of the tubule showing little pathology.

Fig. 13. Low power. Glomeruli and tubules in apparently perfect condition.

She was taken to the operating room on January 2, 1927, and injected with indigocarmin, after which an incision was made over the left rectus muscle, so that it was possible to enter the perivesical space. This was done in the hope that we could find the opening of the ureter. After thorough exploration it was decided to open the peritoneal cavity. Both anterior and posterior incisions were made and the end of the ureter was picked up after some delay as adhesions were present from the previous operation. It was found that the end of the ureter had been tied off and had opened into the cervix. The ureter was somewhat dilated throughout due to a stricture at its distal end. A ureteral catheter was introduced into the ureter and another opening was made into the peritoneum near the bladder. A small opening was made in the posterior wall of the bladder, the distal end of the catheter was introduced into the bladder, and the ureter was implanted in a manner similar to that described in the experimental work. The bladder was then closed. Drains were inserted into the peritoneal cavity and into the perivesical space. A retention catheter was inserted in the bladder and the urine drained through the natural channel.

The patient made an uneventful recovery. On the eighth day the distal end of the catheter was withdrawn from the bladder through the urethra by

Fig. 14. Section from the gross specimen which apparently showed pathology. On microscopic examination very little pathology was evident.

means of a rongeur. The urine appeared perfectly normal; this was confirmed by laboratory analysis. On February 2 the patient was discharged from the hospital as cured. Before discharge a functional test was made. Seventeen per cent of dye was obtained in 15 minutes from the side operated upon. The patient at the present writing (October, 1928) appears to be in perfect health.

CONCLUSIONS

1. In my opinion the Coffey technique is the method of choice.

2. A more extensive study with regard to kidney function, bacteriology, and pathology should be urged.

3. In the treatment of bladder cancer, implantation of the ureter into the large bowel should be practiced.

4. This operation is the one of choice for exstrophy of the bladder.

5. It is more important to guard against the development of a hydronephrosis than to avoid ascending infection. I believe that the danger of hydronephrosis will be eliminated by a change in the technique with reference to the muscularis and mucosa of the bowel. Recently we have invaginated in dogs the muscle at the site of the implantation, to permit healing to take place without impingement of the muscle of the bowel upon the ureter. We have also made the incision in the mucosa larger and have inserted one suture at site of introduction of ureter into bowel lumen to prevent pinching of ureter by mucosa.

I wish to express my appreciation to Dr. Willard Van Hazel and Dr. Chester Guy, who with their co-operation made this article possible.

CLINICAL SURGERY

FROM THE CLINIC OF LORD MOYNIHAN

CHOLECYSTECTOMY

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ALTHOUGH a large number of cases of gall stones are found postmortem in cases dying from other conditions, it is probably never true to say that they have been symptomless, though they may have been unsuspected, during life. A careful inquiry would almost certainly have elicited a history of an "ordinary" indigestion which had been neglected, and we know that no indigestion is ordinary. As a rule it is only when a stone slips down to become impacted in a duct and to cause colic that a patient looks back and recalls the irregular flatulent dyspepsia, which is so typical of the early stages of gall-bladder disease. In the absence of this accident the evidence of gall stones would probably pass unrecognized. We have a further method of recognizing gall-bladder disease and that is by means of cholecystography, which during a routine examination may reveal the presence of gall stones or of their precursor, a cholecystitis. This has been made possible by the work of Graham, who has shown that the absence of a shadow of the gall bladder after administration of the dye is due to disease.

Much has been made of the medical treatment of gall stones but at the best this can do no more than keep the sufferer comfortable. An infected gall bladder left *in situ* is a menace to the general health and may ultimately give rise to a fatal complication. Infection may be absorbed and lead to chronic joint disease and years of unnecessary ill health and suffering. It may be the focus of infection which acts on the stomach or duodenum with the production of ulceration, or it may infect the pancreas, thus causing that rare but fatal complication of acute pancreatitis. Finally, carcinoma of the gall bladder never occurs in the absence of the irritation due to gall stones.

Medicine has a further charge to answer and that is of being responsible for a large part of the mortality of cholecystectomy, small as it is. Death occurs in those cases in which the liver has been damaged by a continuous re-absorption of toxins or by back pressure from a stone which has been impacted in the common bile duct for a considerable time. As in an acute abdominal emergency, the mortality is the mortality of delay.

COMPLICATIONS

Probably nowhere in surgery is an exact knowledge of the normal and abnormal anatomy more necessary than in operations performed on the gall bladder. The variations are few and must be recognized; a failure to do so may be fatal to the patient or the repair of the mistake which has been made may tax the ingenuity of the most experienced and dextrous of operators. These variations have been studied by Flint and recorded in the *British Journal of Surgery*, 1923, x, 509.

The right hepatic artery may pass in front of the common hepatic duct in one case in eight. One case in six, we find, has an accessory cystic artery which usually rises from the right hepatic artery.

The cystic duct is usually bound down to the common hepatic duct for some distance and it is possible to separate them down to the point at which they join to form the common bile duct, which is usually 1 centimeter above the upper margin of the duodenum. Accessory bile ducts are present in one case in seven. All of them are accessory right hepatic ducts and they open into the right hepatic duct or the common hepatic duct, often as low down as its junction with the cystic duct.

Postoperative hæmorrhage is particularly liable to occur in jaundiced patients, but the danger can be minimized before operation by increasing the coagulation time of the blood by means of calcium chloride and by paying particular attention to hæmostasis, at every stage of the operation. A further complication which is seen is an impair-

Fig. 1. The left hand of the assistant acting as a retractor.

Fig. 2. The surgeon's left index finger in the foramen of Winslow, pushing forward a stone in the common duct.

ment of the liver function after operation, the so-called hepatic insufficiency in which the patient usually drains a large amount of thin, clear, or even white bile and gradually gets weaker and weaker and finally dies.

PRE-OPERATIVE TREATMENT

The patient is kept in hospital for some days before his operation, and any focus of infection which may be present, particularly in the teeth, is dealt with. The best method of protecting the liver from the development of an insufficiency is to insure that at the time of the operation it is plentifully stocked with glycogen. With this end in view glucose is given from the day the patient comes into hospital. He may drink it in a 5 per cent solution with 5 per cent of bicarbonate of soda, or if he finds it unpalatable, the taste may be partly disguised by a small amount of orange or other fruit juice. A jug containing this mixture is left at the side of the bed and he is told to drink as much of it as he can manage. The same solution is also given by the rectum with the addition of 5 minims of tincture of opium to a pint of solution, if, as not infrequently happens, it irritates the bowel.

The coagulation time of the blood is estimated, and in those cases in which it is long and in every case in which there is jaundice, calcium chloride is given. Three doses of 5 cubic centimeters of a 10 per cent solution are given intravenously at 12 hour intervals immediately before the operation. The operation area is prepared from the nipples to the upper part of the thighs. It is shaved and the night before the operation it is cleaned with ether soap followed by a 1:2000 solution of biniodide of mercury in rectified spirit. It is then dried and painted over with a 3 per cent solution of picric acid in spirit and covered with a sterile towel, which is bandaged on and is left in position until after the patient has been anæsthetized.

THE ANÆSTHETIC

A preliminary injection of $^1/_6$ grain morphine, $^1/_{200}$ grain scopolamine and, if the patient has any bronchitis, $^1/_{100}$ grain atropine, is given half an hour before he leaves the ward. Anæsthesia is induced by gas and oxygen given through a

Fig. 3. To show the method of passing a ligature round the cystic duct.

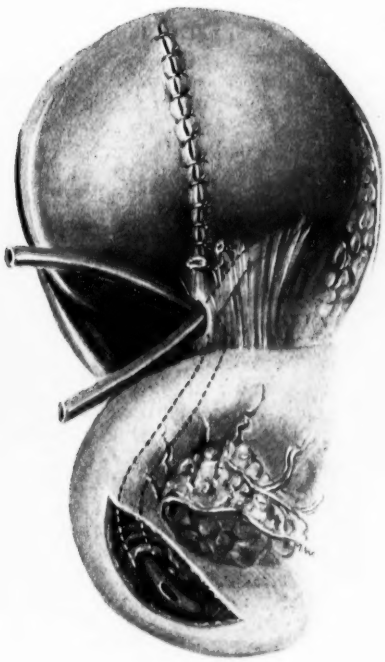

Fig. 4. Gall bladder removed, tubes in position.

Boyle's apparatus and it may be re-inforced by a small amount of ether, when the abdomen is being opened and closed and when the common bile duct is being manipulated. Chloroform has a direct toxic action on the liver cells, which have already been subject to a varying amount of stress, and should never, under any circumstances whatever, be employed.

THE OPERATION

The patient lies on the operating table with a support under the lower ribs. This pushes the upper part of the abdomen forward and renders the gall bladder and its ducts more accessible. As this is an uncomfortable position for the patient to assume when he is conscious, he therefore lies flat on the table with a deflated rubber bag in the required position until anæsthesia has been induced when the bag is filled with air. Some operating tables are fitted with a small platform which can be raised at the necessary site and, if they are used, the rubber bag is not called for.

The operation area is exposed and is cleaned as in the preliminary preparation except that Harrington's solution is substituted for the picric acid. The sheets are next fixed in position—they are green, a color which has been found to be restful for the eyes of the surgeon. The abdomen is opened by means of a right paramedian incision extending from the costal margin to below the umbilicus, displacing the rectus muscle outward. This incision gives a good approach to the gall bladder and has the great advantage that it leaves a perfect scar afterward. It is therefore employed in every case except in the extremely fat patient, in whom a subcostal incision gives better access. Every bleeding point is seized by means of artery forceps and is ligated before the intra-abdominal part of the operation is proceeded with. It is important that the wound should be absolutely dry, as bleeding is very likely to go on and lead to bruising, or, in the more persistent cases, to the formation of a hæmatoma. The skin edges are protected by tetra cloths and the peritoneum is opened.

The stomach and duodenum are inspected carefully and then the rest of the abdomen is rapidly reviewed by palpation. In the absence of any further disease the cæcum is pulled up into the lower angle of the wound and the appendix is removed. Attention is now paid to the gall bladder which is inspected and then palpated for stones. Finally, the left index finger is inserted into the foramen of Winslow and the common bile duct is carefully rolled between it and the thumb. When the hand is moved up and down it is possible to examine the whole length of the duct, even down to the ampulla of Vater.

It is never necessary to open the duct in order to see whether it contains a stone; careful palpation and familiarity with the region are all that is necessary, and even the smallest of stones can be thus detected. If a stone is found it is to be removed before the gall bladder is dealt with, as a little gentle traction on the gall bladder will make the common duct very much more accessible.

The rest of the abdomen is packed off with mackintosh swabs and the left hand of the assistant, placed on top of them, acts as a retractor and prevents the intestines from pressing up into the operation area. Everything depends on the way this retraction is done, and a well trained assistant can make easy what would otherwise be a very difficult operation.

A slight rotation of the liver around its transverse axis is possible and makes the ducts more accessible. The free edge of the liver is pulled downward and then forward and upward out of the wound. It is held in this position by forceps applied to the gall bladder and is kept warm and moist with a mackintosh swab.

The gall bladder close to the opening of the cystic duct is seized by a Parker's clamp and drawn upward as much as possible. The stone or one of the stones lying in the common duct is manipulated until it lies between the upper border of the duodenum and the cystic duct, and in this situation it can be made prominent by a finger in the foramen of Winslow and can be cut down onto with perfect safety. Stones are evacuated through this incision until the duct is clear and a malleable probe is passed downward through the ampulla of Vater into the duodenum. In cases in which there is a thick sediment lying in the duct, it may be cleaned out by a wisp of gauze, which can be pushed up into the hepatic ducts if necessary.

Finally, a thick walled tube is passed upward to drain off the bile and a catheter is passed downward until its end can be felt in the duodenum, and the wound in the duct is partially closed by stitches until it fits closely around these two. The tubes themselves are fixed to the sides of the opening by a stitch, as they would otherwise tend to be expelled too early. This catheter in the duodenum is of the greatest value as it provides a means by which fluids and particularly glucose can be administered from the moment the patient is back in bed if necessary.

Attention is now turned to the gall bladder and its ducts are identified. It cannot be too strongly insisted on that nothing is to be done until the cystic duct, the common bile duct, and the common hepatic duct are recognized. To do this the peritoneum covering the front of the cystic duct is divided with scissors and together with the underlying fat is stripped off the ducts by gently wiping them with a gauze swab. Only one snip with the scissors is necessary, after that everything is done with the gauze held in a long pair of dissecting forceps. Sometimes this step may take a little time, but, even in the most adherent cases, the anatomical relations can be displayed clearly. When this has been done the tip of a pair of curved cholecystectomy forceps is thrust, from the right side, through the triangle bounded by the cystic duct, the common hepatic duct, and the cystic artery. If the blades of the forceps are now opened they will free the cystic duct for a small distance and separate it from the common duct in those cases in which the two are bound up together. A piece of stout catgut is seized by the forceps which, when they are withdrawn, thread it behind the cystic duct, and the cystic duct is tied. If this ligature is too close to the common duct, it may be the cause of the development of a fibrous stricture in that duct and therefore it should be applied at a point 2 millimeters from the junction. The ends of this ligature are brought out of the wound and left long. The cystic duct is clipped above the ligature by a pair of cholecystectomy forceps and divided with scissors between the two. The cut ends are sterilized by being touched with pure carbolic acid. A little further gauze wiping will render the cystic artery obvious and a ligature is passed round it by the method which was used for the cystic duct and it is divided. It is not uncommon to find an accessory cystic artery a little farther back which will also need to be ligated before the gall bladder can be removed. The gall bladder is stripped forward from its bed. This can be done quite well with the finger, a pair of scissors being used to divide the peritoneum on each side as the separation goes on. Finally, in the cases in which there has not been a recent acute attack, the

peritoneum is drawn across the gall-bladder fossa by means of three or four stitches.

Sometimes there is a little oozing of blood from the raw surface of the liver but this usually stops if a hot saline swab is left in contact with it for a few minutes. Rarely, when the hæmorrhage is more persistent, a pack may be left in and removed at the end of 48 hours. A drainage tube should always be left down to the operation area, or rather to the right kidney pouch, and this tube is held in position by having the ligature from the cystic duct, which was purposely left long, tied loosely around it. Finally, an omental veil is made by stitching the falciform ligament to a piece of the right side of the great omentum and this veil is gently pushed up so as to separate the first part of the duodenum from the gall-bladder fossa.

The support is removed from under the patient's ribs, and he is brought down flat before the abdominal incision is closed. The peritoneum is closed by means of a continuous suture, after which the tetra cloths are removed and the skin is swabbed over with the biniodide of mercury in spirit solution. Deep silkworm gut stitches which include the rectus sheath are inserted but not tied, the rectus sheath is closed with interrupted catgut stitches and the skin edges are approximated with Michel's clips. The silkworm-gut stitches are threaded through a piece of fine rubber tubing before they are tied and a dressing is applied.

The patient is taken back to the ward and, as soon as he has recovered from the anæsthetic, he is propped up in Fowler's position. In cases in which a tube has been put through into the duodenum, glucose is administered through it by means of a continuous drip, or in the cases in which the common duct has not been opened it is given by the rectum.

The thick walled tube, which is draining the common hepatic duct, is connected up by an extension to a bottle at the side of the bed into which the bile drains for some days. The stitch which keeps it in position usually holds for about 14 days, when it and the duodenal catheter begin to work their way out. As soon as these tubes are out, some bile begins to find its way down the common duct, the fæces become colored, and in 2 or 3 days the wound dries up. The tube which was put down to the right kidney pouch should be removed after 48 hours. It usually comes out quite easily, but in very nervous patients or in those in whom a gauze pack has been left, a whiff of gas may be given with advantage. This pack comes out much more readily if a little hydrogen peroxide is poured onto it two or three times before it is taken out.

Patients usually complain of a good deal of flatulence for 2 or 3 days after the operation, but if a rectal tube is used, enemata are given and, if necessary, small doses of eserine, they can usually be kept comfortable. This condition usually becomes a good deal easier after 48 hours, when the big tube is taken out, which would appear to suggest that its presence may have some inhibitory effect, from direct contact, on the movements of the large intestine.

Patients are allowed to get out of bed at the end of a fortnight, or when the tubes have all come out, and they are able to leave the hospital 3 weeks after the operation.

FROM THE SURGICAL CLINIC OF GUY'S HOSPITAL

CHOLEDOCHOTOMY

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INCISION and exploration of the common bile duct is often required to find out and, if possible, to remove the cause of recurrent biliary colic or obstructive jaundice. The association of these two symptoms is nearly always due to gall stones obstructing the common bile duct, but occasionally severe pain, if not typical colic, accompanies jaundice due to malignant disease obstructing the common bile or common hepatic duct. When the latter is obstructed the gall bladder is not enlarged, thus making the mimicry of gall stones all the more puzzling. It is well known, as Courvoisier pointed out many years ago, that jaundice without enlargement of the gall bladder is generally due to calculous obstruction of the common duct, whereas jaundice with enlargement of the gall bladder is usually due to other causes such as malignant disease or chronic inflammation of the head of the pancreas. It is often impossible to ascertain the cause of chronic jaundice without exploring the bile ducts; if the cause prove irremovable, cholecystogastrostomy generally prolongs life, relieves the jaundice, and stops the intolerable itching. Occasionally it is necessary to operate for cholelithiasis during intractable jaundice, but whenever possible it is safer to wait for an interval between the attacks of colic with jaundice, and it is especially desirable to wait for the subsidence of any fever due to cholangitis. It is vitally important to realize that stones may exist in the common bile duct for years without ever causing jaundice, and that it is therefore necessary to examine very carefully for stones in the common bile duct during every operation upon these parts. When there is grave doubt it is wise to open the common bile duct and to pass a large pliable probe, both upward into the hepatic ducts and downward through the papilla, into the duodenum.

DIFFICULTIES, DANGERS, AND POSSIBLE COMPLICATIONS

It is imperative for every surgeon, who undertakes operations upon these intricate parts, to know the many pitfalls that await him (Fig. 1). There are many variations in the[1] anatomy of the bile ducts and of the arteries and veins in close relation to them; moreover pathological changes, such as congestion, inflammation, œdema, fibrosis, contractions and adhesions, and perhaps malignant disease, so alter the appearance and feel of the parts, that adequate exposure, great caution, and endless patience and discretion are necessary to enable the surgeon to identify and display the ducts adequately before the common duct is opened. Failure to observe these precautions may lead to intractable hæmorrhage or serious and perhaps irreparable injury to the bile ducts or duodenum. The ducts need very careful exploration with the finger or probe, otherwise one or more stones may be left behind. Inflammatory thickening around a small stone impacted in the second or third part of the duct is especially liable to be mistaken for carcinoma, and the stone may be overlooked unless the duct is opened and explored. Sometimes it is necessary to open the duodenum to ascertain the nature of a swelling at the duodenal papilla.

[1] R. P. Rowlands. Surg., Gynec. & Obst., 1927, xlv, 518.

PREPARATION OF THE PATIENT

The need of this operation is rarely, if ever, urgent; therefore it always pays to prepare the patient with care and deliberation. He is kept at rest for at least 2 days before the operation. An aperient is given not later than 24 hours, followed if necessary by an enema 8 hours before the operation. The mouth and teeth are frequently and adequately cleansed, and the operation is deferred if necessary until all signs of oral or nasal sepsis have been eliminated. It is particularly important to wait if there are any indications of an oncoming catarrh of the nose, throat, or respiratory organs, on account of the danger of pneumonia supervening. If blood clotting is delayed from long continued jaundice, I inject intravenously 5 cubic centimeters of a 10 per cent sterile solution of calcium chloride once a day for 2 or 3 days before the operation, and to meet any depreciation of the liver function, I give glucose solutions freely by mouth, rectum, or intravenously. The day before the operation the skin of the abdomen is shaved if necessary and a warm bath given. On the morning of the operation the skin of the abdomen is painted with tincture of

iodine, and this is repeated when the patient is under the anæsthetic.

OPERATION

The deeply placed common bile duct is made more accessible by means of a soft rubber air cushion placed behind the lower part of the chest or by the raising of the bridge situated here. This opens out the costal angle, brings the bile duct well forward, and makes the intestines fall out of the way toward the pelvis. The head and thighs are also flexed to relax the abdominal wall. A paramedian incision, half an inch to the right of the middle line extending from the right epigastric angle to the level of the umbilicus, gives excellent exposure of the common bile duct and is therefore the most useful for dealing with disease limited to the duct. Moreover, very little bleeding occurs from this incision, an important point when jaundice is present. This approach is especially selected in recurrent cases when other incisions have been made farther out in the usual situations, for troublesome adhesions may thus be avoided. If the gall bladder needs removal and more room is required, the rectus can be cut across at the lower end of the incision after the method of Perthes. Every bleeding point is immediately tied with fine catgut before the peritoneum is opened. The abdomen is rapidly but carefully explored so that no disease or complication may be overlooked, then the biliary apparatus is carefully inspected and palpated to ascertain the cause of the symptoms, and the exact plan of action is now decided upon. The duct may be opened above, behind, or through the duodenum, but the first of these is usually the method of choice.

Supraduodenal choledochotomy. Any omental and other adhesions are carefully separated by gauze dissection, care being taken to avoid lacerating any of the adherent viscera, especially the first part of the duodenum; every bleeding point is tied at once. The edges of the parietal wound are enfolded with large, moist, fixed gauze pads, and the right kidney pouch is packed with a long dry gauze roll secured at its projecting end. If possible, the liver should be pulled downward and forward and then tilted so that its lower surface is well displayed. The assistant, with his right hand, holds the tilted anterior border of the liver and the gall bladder and with two or more fingers of his left hand hooks and pulls downward and inward the pylorus, thus stretching the edge of the gastrohepatic omentum and displaying the front margin of the foramen of Winslow, while the surgeon closely examines the ducts. Every

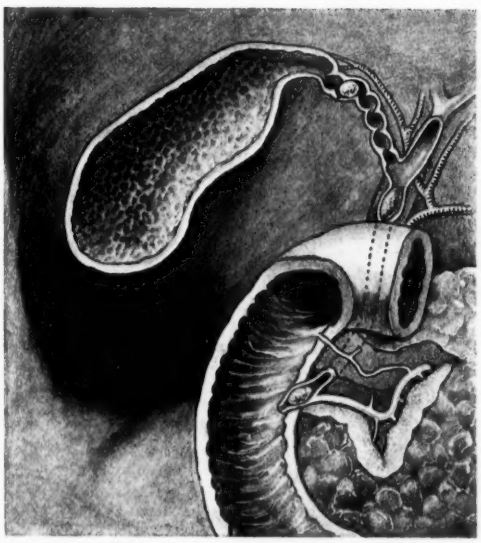

Fig. 1. Anatomy of the biliary apparatus. Stones are shown in the cystic duct, common bile duct, and ampulla of Vater. The pancreatic duct of Wirsung and the accessory duct of Santorini are shown, the latter opening separately into the duodenum.

gall stone discovered in any part of the common duct is, whenever possible, displaced upward into the first part of the duct whence it can be removed with the greatest ease and safety (Fig. 2). The left index finger is passed into the foramen of Winslow, behind the common bile duct, and the whole of the duct is carefully palpated as the thumb is moved down along the front of the duct as far as the duodenal papilla. It is much easier to push the stone backward before the duct is incised and the bile is let out, thus allowing the duct to collapse above the stone. Once displaced into the first part of the duct it is raised and firmly held up by the finger behind it. The incision in the peritoneal covering of the duct is cautiously made directly over the stone and well above the duodenum in order to avoid the blood vessels which commonly cross in front of the duct low down near the bowel. Any vessels lying in front of the duct are displaced inward by blunt dissection, thus exposing the greenish white dense wall of the duct which, with the bulging stone within, protrudes from its peritoneal and fatty sheath. The position, consistence, and greenish color serve to distinguish the duct from the portal vein, which has been mistaken for it and opened. Fortunately, the vein invariably lies behind and to the left of the common bile duct so that it is not often seen

Fig. 2. Choledochotomy. Exploration of the bile ducts. All ducts and hepatic artery are seen, and a finger in foramen of Winslow holds up a stone in common bile duct.

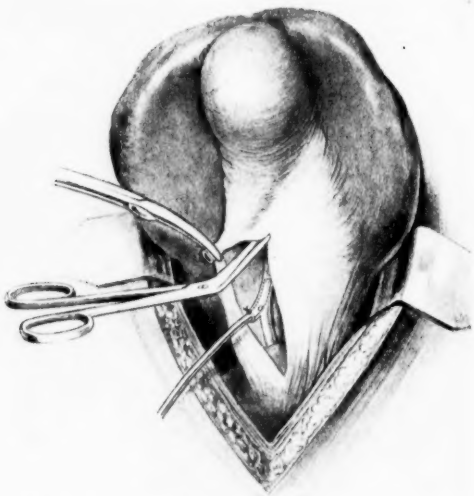

Fig. 3. Cholecystectomy and choledochotomy. A method of draining the common bile duct through the stump of the cystic duct is shown.

during this operation. If there be any doubt it is wise to aspirate with a glass syringe and a long fine needle. If the vein be accidentally opened, the bleeding can be instantly checked if it is seized with the finger and thumb or artery forceps, and the opening is closed with a suture of fine linen thread, which is more secure than catgut. An ample longitudinal incision is made into the duct so that the stone often shoots out or is pressed out by the finger behind the duct. Two mattress sutures may be introduced into the wall of the duct before it is incised. These serve to close the incision afterward and also act as valuable guides. I have often used rotation of the duct as recommended by Lord Moynihan with great advantage; for when the gall bladder is shrivelled, empty, and embedded in adhesions, and the patient is too ill for a prolonged operation, the adhesions need not be separated, but with the left hand passed to the left in front of the lesser omentum, and the fingers flexed, the common duct with the stone within it as a guide is pushed to the right and forward into view from behind the adhesions. A suture is passed into the duct wall to anchor it, and an incision is made over the stone in the usual way. Much time and trouble may be saved by this maneuver.

The escape of bile, which may be profuse and often infective if it has been pent up or if the blocked duct is dilated, must be met by assiduous sponging and previous packing of the kidney pouch of the peritoneum. After removal of the main stone the ducts must be thoroughly and systematically explored, for, as has already been pointed out, there are often several stones present and the failure to remove them all will render the operation more or less useless. In late cases of obstruction of the common duct, stones may have formed in or backed into the hepatic ducts and may be overlooked and give rise to recurrence of symptoms. This exploration should be carried out with the finger if the ducts are sufficiently dilated, or failing this, with a long pliable probe and scoop. The finger, however, should be employed whenever possible, because it is the most certain. It is passed both up and down. By conjoint work from within and without the duct, a stone impacted low down may be dislodged and removed. A large olive-headed probe should be passed into the duodenum to make certain that the papilla is patent and to enlarge the opening if necessary, so that any stone or débris left behind may easily escape into the bowel. It is often wise to clear out débris by means of a gauze strip passed into the duct. W. J. Mayo[1] states: "In nearly one-third of the deaths which followed operation on the common duct for stone in one series, autopsy revealed that all stones had not been removed."

[1]Lancet, 1923, i, 1299.

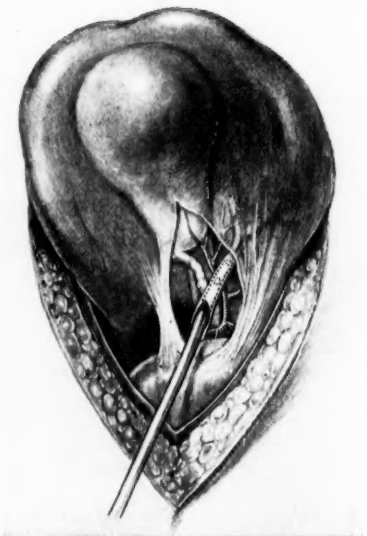

Fig. 4. Choledochotomy. The drainage tube has been passed through the opening in the common bile duct, upward into the common hepatic duct.

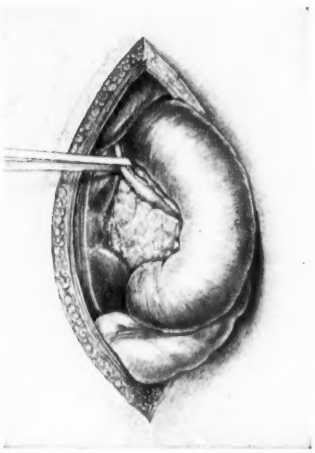

Fig. 5. Retroduodenal choledochotomy. The stone is firmly impacted in the second part of the common bile duct, behind the duodenum, which has been mobilized and turned over to the left. The duct was embedded in the head of the pancreas.

At this stage the gall bladder is treated, if necessary; as a rule it is removed if it is certain that the common bile duct is patent, and if there is no added risk, especially from bleeding, the result of long continued jaundice or adhesions.

Drainage. The ducts having been cleared, it remains to consider the best methods of drainage. When the gall bladder has not been removed, and the cystic duct is patent, a tube inserted in the gall bladder and a large tube in the kidney pouch will provide enough drainage (Fig. 3). Similarly after cholecystectomy has been added the common duct can be conveniently drained through a dilated cystic duct. Even when indirect drainage through the gall bladder has been established, it is rarely advisable to close the incision in the common bile duct, and especially if there is septic cholangitis it is better and safer to drain it. Moreover, blood clots[1] or stones overlooked in the hepatic ducts may occasionally obstruct a sutured duct. A long rubber tube 1/6 of an inch in diameter is passed into the common duct and upward toward the common hepatic duct and secured in position by means of a fine catgut suture, which pierces the tube and the edges of the wound in the peritoneal sheath of the duct (Fig. 4). The part of the tube within the duct lies loosely and has one or more side openings in it, so that bile may still pass down the common bile duct. One or more catgut sutures may be inserted if necessary to close the opening in the duct snugly round the tube. To prevent contamination of the peritoneum and parietes, a rubber tube ½ an inch in diameter is always passed into the kidney pouch below and outside the wound in the common bile duct. In some cases, especially when a vertical parietal incision has been used, drainage may be established through a stab wound in the right flank, so that the median wound can be completely closed and hernia thus avoided. If the Kocher incision has been used, the drainage tube will lie in the lower and outer angle of the wound. The bile is conducted into a babies' feeding bottle by the side of the patient, secured in proper position by tapes. In all cases it is wise to sew the tubes separately to the skin so that they may not be accidentally withdrawn. The fine tube will become detached from the duct in about a week and should then be removed. The larger tube draining the kidney pouch may be safely and easily withdrawn after 2 or 3 days. Gauze wicks, plugs, or packs are unnecessary and harmful; their removal causes needless pain, delay in healing, and sometimes hæmorrhage.

Retroduodenal choledochotomy. If possible, the stone should be passed upward into the first part of the duct or drawn up by fine curved forceps, whence it can be more safely and more easily removed. Failing this, the duodenum may be mobilized by the incision of the parietal perito-

[1] R. P. Rowlands. Guy's Hospital Reports, 1912, lxvi, 219.

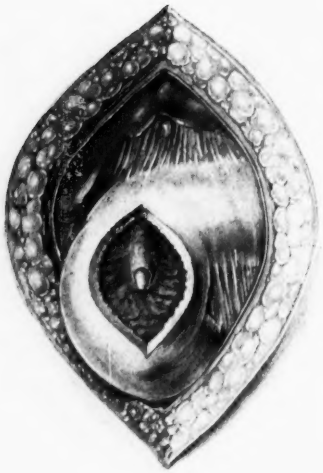

Fig. 6. Duodenocholedochotomy. The second part of the duodenum is brought into the wound and packed off. Vertical incisions are made in the anterior wall of the duodenum and end of the bile duct.

neum about an inch to the right of the descending part and turning the latter forward and inward (Fig. 5). Then the calculus is sought and, if found, it serves as the best guide to the duct, which may be embedded in the head of the pancreas. When the stone has been found it may now be possible to push it back into, and to remove it from, the supraduodenal part of the duct. If this is not possible the duct must be incised over the calculus, which is removed, and drainage always established. The objections to this route are that it is difficult and may be accompanied by troublesome hæmorrhage from the pancreas, but usually the pancreatic tissue around the duct is fibrous from chronic inflammation and does not bleed much. Bleeding is best controlled by suture. In some cases it is easier and safer to adopt the transduodenal route, as Kocher did in one case on account of severe hæmorrhage from the pancreas which made him give up the retroduodenal route.

Transduodenal choledochotomy, duodenocholedochotomy (Figs. 6 and 7). Dr. McBurney was the first to perform this operation in 1891. He laid stress upon the following procedure:

In all cases which are not complicated by very deep adhesions involving the common duct and descending portion of the duodenum, it is easy and very desirable after determining the presence of the calculus in the lower part of the duct to pass the left forefinger through the foramen of Winslow to a point behind the calculus. With the finger, the lower end of the common duct, the calculus, and the descending portion of the duodenum can be lifted forward so as to bring these parts nearly or quite to the level of the abdominal incision.[1] The duodenum is then incised on its anterior wall from an inch to an inch and a half, the orifice of the duct (which is usually markedly altered as to the color, etc.) is easily found and enlarged with knife or scissors or forceps and the stone removed.[2]

If an incision has been already made into the common bile duct in its first part, a piece of gauze may be drawn downward from it into the duodenum, thus removing any débris; but if free drainage is established into the duodenum, it is not necessary to make a separate incision for drainage of the common bile duct. When a stone is impacted higher up the duct and cannot be extracted through the incised papilla in this way, it may become necessary to cut upon it through the posterior wall of the duodenum and the anterior wall of the second or third part of the duct after Kocher's method. The edges of the incision in the duct are sewed to those of the wound in the back wall of the duodenum to prevent bleeding and to maintain a free opening into the duodenum. The duct is then explored for more stones by passing up a finger or flexible scoop. The longitudinal anterior duodenal incision is closed in the usual way with two continuous sutures of fine catgut, the wound being drawn transversely to the axis of the bowel before it is closed, so that stricture may be avoided. A flap of the convenient transverse mesocolon is then sewed over the suture line to reinforce it. This method being more severe and dangerous than opening the bile duct above the duodenum, is, of course, only suitable for cases in which it is found impossible to back the stone into the first part of the duct without undue force being used. The death rate from this operation will probably remain a little higher than that of supraduodenal choledochotomy, because most patients needing it are more ill and exhausted from long continued complete obstruction of the bile and pancreatic secretion. Moreover, in the past the risks of death from duodenal fistula and from hæmorrhage were greater. But with more accurate diagnosis, earlier operation, and great care in sewing the duodenum and in preventing hæmorrhage, the risks of this excellent operation have been greatly reduced in recent years.

[1] If the duodenum is not mobile enough, the peritoneum to the right of it may be incised to the required degree.

[2] J. C. Hancock. Ann. Surg., xliii, 72.

AFTER-TREATMENT

After his return to bed, the patient is placed horizontally upon his right side, with only one pillow. He is kept warm and immediately given per rectum one pint of 5 per cent solution of glucose, containing 60 grains of sodium bromide and 30 grains of aspirin. This enema is repeated, if necessary, the same evening. As soon as the patient is round from the anæsthetic and any shock has passed, he is placed in a comfortable semi-sitting position. If necessary, heroin ⅙ grain is given subcutaneously about 9 p.m. and repeated about 4 hours later and perhaps the second night. This drug, however, is reserved for the nights; aspirin and bromide being substituted, if required during the day. From the beginning, water is given freely by the mouth and the diet is rapidly increased so that full diet is generally given in small meals on the fourth day. This is better than a more restricted diet and avoids trouble with the bowels.

After the first day, the rectum is washed out every morning with plain water. Paraffin, 1 ounce, is given twice a day from the beginning and if this is insufficient 1 ounce of castor oil is given on the third morning. If vomiting is troublesome, large drinks of water containing bicarbonate of soda are given freely by the mouth, and if this fails the stomach tube is used. If flatulence is troublesome, pituitrin is given subcutaneously and a turpentine enema is used and generally affords great relief.

COMPLICATIONS

Reactionary hæmorrhage rarely follows this operation nowadays, owing to the better preparation of the patient and better hæmostasis, but if it does it may be necessary to reopen the wound, without delay, to tie any bleeding vessel. In late cases of long continued jaundice, oozing of blood may occur at any time up to a week or 10 days after the operation. This is best met by the administration of calcium chloride intravenously, blood transfusion, or the injection of hæmoplastin.

Unless great care has been taken in placing the drainage tubes, extravasation of bile may occur into the greater or lesser sacs of the peritoneum, thus causing diffuse or localized peritonitis. With the former, distention of the abdomen, tenderness, and moderate rigidity, with dullness in the flanks, soon develop and the abdomen has to be reopened and drained, a tube being placed in the lower abdomen. With the latter, the escape of bile into the lesser sac causes great pain and collapse and later an epigastric swelling of the characteristic shape of the lesser sac. This is best drained, without delay, through a left paramedian epigastric incision, reaching the lesser sac either below or above the stomach (generally below).

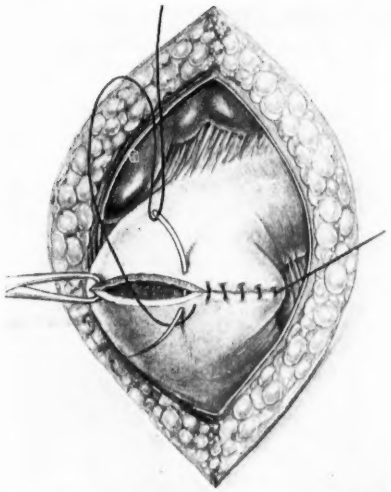

Fig. 7. Duodenocholedochotomy. The wound in the duodenum is drawn into the transverse position and closed with two layers of catgut suture and sealed over with a flap taken from the mesocolon just below it.

Recurrence of colic sometimes takes place after choledochotomy and this may be due to a spasm of the duct around the tube, blood clot, or even débris of stone in the duct. Heroin or morphia has to be administered to relieve the pain. Remittent or intermittent fever occasionally follows choledochotomy and is usually due to cholangitis. For this, the administration of urotropin or sodium salicylate and magnesium sulphate is indicated. In late cases, wasting and anorexia, sleepiness, and even coma may develop because of cholæmia. These are grave signs which are to be met by the giving of large quantities of water and glucose per rectum, subcutaneously or intravenously. Moynihan administers these through a tube passed through the common bile duct into the duodenum.

PROGNOSIS

Mortality. Although many of the patients requiring choledochotomy are bad subjects, the mortality from the operation when taken in time is surprisingly small—from 2 per cent to 6 per cent, varying with the duration of jaundice, the site of the stone, the amount of work to be done at the operation, and above all the absence or presence of infection of the common bile duct before or after the operation.

E. S. Judd and J. H. Lyons,[1] analyzing the mortalities of operations upon the biliary passages performed by ten surgeons at the Mayo Clinic during 1922, record 4 deaths in 150 choledochotomies.

Recurrence of symptoms. Recurrence of symptoms after choledochotomy is a rare event nowadays when the operation is performed without delay and before infection of the bile ducts has taken place. When they do occur, they may be due to stones or débris left behind in the biliary passages.

[1] Ann. Surg., 1923, lxxviii, p. 194.

This is not entirely avoidable on account of the complicated nature of the biliary apparatus and the lateral pouches that may form in the common bile duct. When the gall bladder has not been removed, fresh gall stones may form in the gall bladder and cause recurrence of symptoms, and this is an important reason for the removal of the gall bladder whenever possible without adding to the risk of the operation. Recurrence of symptoms may also be due to spread of infection to the pancreas or to adhesions between the pylorus or duodenum and the liver at the site of the gall bladder.

THE TECHNIQUE OF COMBINED ABDOMINOPERINEAL RESECTION OF THE RECTUM[1]

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Division of Surgery, The Mayo Clinic

DOGMATIC, arbitrary assertions that any one operative maneuver may be so standardized as to be applicable as a routine in the extirpation of carcinoma of the rectum and rectosigmoid is indicative either of inexperience or of a studied disregard for statistical information on the part of the commentator. Even a cursory glance at mortality tables or morbidity studies emphasizes the necessity of multiple procedures in meeting this surgical situation which is so fraught with technical difficulties and which not uncommonly is associated with serious complications and unpleasant sequelæ. Search for an ideal type of operation with low mortality and short hospitalization is unrewarded, and experience indicates that at least five types of maneuver are essential in the handling of these cases. I name them in the order of their desirability without reference to their application, which should be decided by mature judgment based on clinical experience: (1) abdominoperineal resection in one stage; (2) graded abdominoperineal resection in two or three stages; (3) colostomy and posterior resection; (4) local attack by posterior resection without colostomy, as in the Quénu-Tuttle or Harrison Cripps variety of operation, and (5) palliative procedures, such as colostomy, local cauterization, and local excision.

The first three types of procedure mentioned will be the choice of practically all surgeons to whom patients come for relief when the disease is in an operable stage. Local extirpation will be used only in an occasional case, because it fails to give information relative to abdominal metastasis and because of the undesirability of leaving an uncontrollable sacral anus. Instances in which this procedure is used will be largely at the insistence of the patient because of his dislike for an inguinal colostomy opening. The field for palliative procedures, such as colostomy in case of obstruction, as well as destruction by cauterization, may be extended to include those groups of cases which are better treated by colostomy and radium or by radium alone. Moreover, in certain instances, radium has effected a five year cure when used alone or in combination with a drainage operation, and the tendency is increasing to employ it more frequently in growths proved by biopsy to be highly malignant.

SELECTION OF CASES FOR OPERATION AND OF OPERATION FOR CASES

Selection of cases for operation is not more important than proper selection of operation for individual cases. Both factors are vital in widening rather than narrowing the scope of individual surgical procedures and in increasing the horizon of operability rather than in diminishing it. In the matter of selecting cases to which each operation is most applicable in the hope that the highest percentage of ultimate cures and the lowest percentage of immediate mortality may be combined, one immediately finds wide divergence of opinion among surgeons and enters on debatable ground in attempting to define or standardize exactly what operability means. Although general rules may be laid down for the vast majority of cases, and little difficulty is experienced in the allocation of the cases, few fields of surgery offer so little opportunity for extreme standardization or demand more varied technique in application or experience in the selection of therapeutic measures.

Obviously, metastasis to the liver, as demonstrated at exploration, rules out subsequent attempts at eradication of the local malignant growth except in extreme instances. In gastric surgery occasionally one may resect a carcinoma of the pylorus as easily as one may do a gastroenterostomy.

In surgery of the colon, however, the analogue is not followed; that is, resection of any segment of the colon cannot be accomplished with the simplicity, ease, and low mortality of a drainage operation proximal to a growth. Involvement of lymphatics does not rule out radical operation, since the hope that one may by block dissection remove all of the invaded lymphatics is ever present and, on the other hand, one rarely can tell that the lymph nodes are malignant until they have been removed and examined microscopically. Enlarged lymph nodes in the vicinity of a carcinoma mean nothing. More frequently than not, they are benign and inflammatory, secondary to the ulceration which is always present with carcinoma.

The anatomical conformation of the individual, although by no means a standard for rejection of a patient for operation or an infallible aid in selecting the type of operation, always influences

[1] Submitted for publication January 30, 1920.

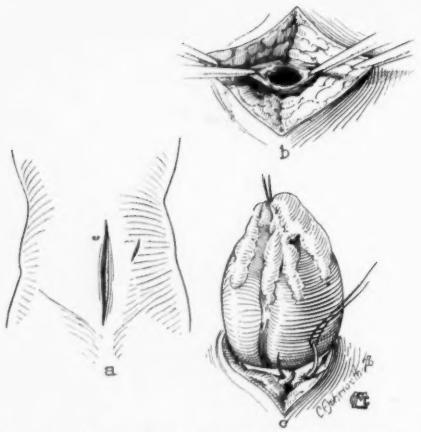

Fig. 1. a, Median line incision for exploration and other steps of operation. Stab wound, midway between umbilicus and anterior superior spine for colostomy. b, Small opening in peritoneum through which the sigmoid is drawn. The other layers of abdominal wall are incised more widely to prevent constriction. c, The closed-off proximal sigmoid is brought out through the stab wound and the peritoneum is closed snugly around it without the application of sutures into the wall of the bowel. Other layers are closed loosely or an iodoform gauze pack is wrapped around the bowel and the wound is permitted to heal by granulation.

one's judgment of which procedure can be accomplished best and most safely. Short persons, inclined to obesity, present poor risks for any surgical procedure. It is a clinical observation that patients of this type who harbor malignant neoplasms not only stand extensive technical procedures poorly because of lack of resistance and because of the ease and rapidity with which local infection often proceeds to lethal peritonitis; but the ultimate prognosis in such cases is relatively poorer than for the thinner, muscular type of patient. I do not know that there is any anatomical type which may be called "a cancer type," but the types that are poor risks for surgical procedures in chronic disease are a higher risk for surgical procedures involved in the removal of malignant tumors.

Most patients suffering from carcinoma are beyond middle life and are undergoing retrograde changes of approaching senescence, a fact to their advantage, since the less active tissues more readily resist invasion of carcinoma than the elastic vitality of youth. Persons who have pursued laborious tasks necessitating much exertion for a long period of time and who retire to sedentary life, and subsequently develop carcinoma, should be considered as presenting high risks; invariably their resistance is much lower than one would ordinarily judge. Many other factors enter into the task of gauging patients' general resistance to carcinoma, such as prolonged concurrent disease. Examples are diabetes, nephritis, marked evidence of focal infection, or other debilitating conditions which would not ordinarily prove to be great handicaps.

The age of the patient long has been recognized as a factor in malignancy. It is well known that young persons, although capable of standing wide extirpation, have a bad prognosis because of the likelihood of spread of the carcinoma in active tissues. I have recently reviewed the cases of carcinoma of the rectum in young persons at The Mayo Clinic, and although I am not able to report in detail, the unhappy trend of the curve in the prognosis is apparent.

Of all factors which modify the selection of operation, as well as the employment of other agents in combating carcinoma, I believe the relative intensity of the malignant invasion, as estimated by Broders' index of malignancy, is the most important. One gains little when, by brilliant technique, one succeeds in extirpating without immediate mortality an intensely malignant tumor in a young man if one knows that the outcome shortly is death and in such an extremely high percentage of cases that there is small argument in favor of employing radical surgical procedures at all. My own feeling is that malignant conditions of the rectum, graded 4, and those graded 3 likewise, under certain conditions, are best not treated by radical measures. These types of tumor are more highly radiosensitive and less susceptible to surgical eradication; consequently it has been my practice for the last 2 years to refer patients with these conditions for treatment by radium, in the hope that such treatment may accomplish more either in palliation or cure than surgery could offer. Of course, if obstruction is subacute, or complete obstruction is imminent, one should not hesitate to perform colostomy prior to the administration of radium, especially since the first action of radium is to produce œdema and swelling of the tissues with concurrent stenosis of the intestinal canal. This occasionally will necessitate emergency colostomy if it has not already been performed prior to the administration of radium. For this reason I believe it highly necessary that the amount of obstruction be accurately gauged before administration of radium, and if the impingement on the lumen of the intestine is deemed sufficient, that the operative measure be employed first. Occasionally these patients without obstruction are successfully treated without colostomy and there

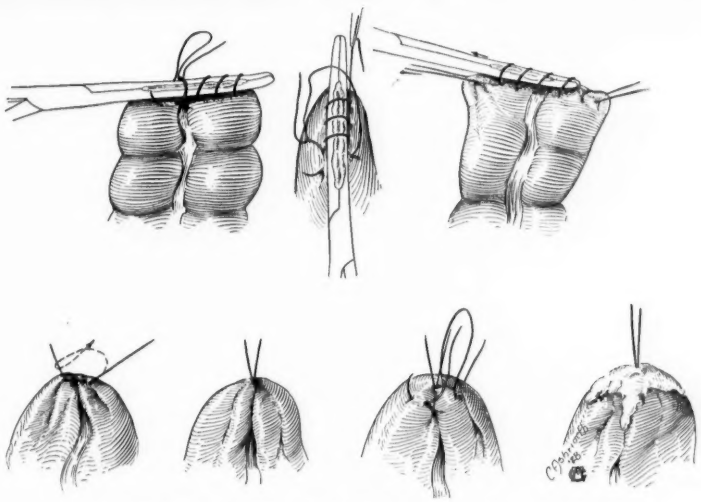

Fig. 2. Steps in the application of suture and inversion of bowel stumps.

is a small series in the clinic which has not been operated on at all but has been subjected entirely to treatment by radium. The series is too small and the time too short to warrant an opinion as to the utility of these measures; however, I believe that in the present state of knowledge concerning prognosis in carcinoma of the rectum, these highly malignant tumors are better treated by a combination of radium and surgical procedures or by radium alone than by an extensive and highly difficult technical operation.

My practice has been to make a biopsy of the tumor at the time of the proctoscopic examination. The biopsy is done not so much with the idea of making a diagnosis, because with the proctoscope and examining finger one rarely needs further evidence that carcinoma is, or is not, present, but with the idea of securing tissue for microscopic examination to ascertain the grade of the carcinoma. Only an extremely small amount of tissue is necessary, and this may be obtained very easily, and without undue trauma, by means of a cautery knife. I do not believe that there is much, if any, danger of spreading the malignant cells by removal of this small piece of tissue.

Although one would hesitate to cut into a carcinoma of the breast or to open a colon to obtain a piece of tissue, I believe that the situation is entirely different in rectal carcinoma. I doubt very much if biopsy produces as much trauma as the constant passing over the area of the hard column of fæcal matter which irritates it daily, or if biopsy offers any greater likelihood of spread of the disease.

GRADING OF MALIGNANT CONDITIONS

I believe that the grading of malignant conditions permits widening of the horizon of operability. It permits the undertaking of radical

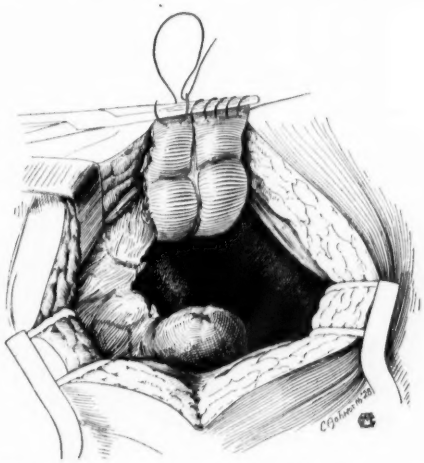

Fig. 3. The distal end has been turned in with a purse-string suture and dropped back into the free peritoneal cavity. The proximal end is being turned in with a running Cushing suture which makes it more readily handled than if the clamp is left on.

Fig. 4. Sagittal section showing the bowel with carcinoma at the rectosigmoid juncture and the relationship of various anatomical structures. At this point, where the bowel has been turned in and dropped back, operation may be suspended as a graded procedure or may be completed as a one stage combined abdominoperineal resection.

extirpation of huge, fixed growths which are not too immobile, because it shows them to be of a low grade of malignancy. The tendency to undertake such difficult technical procedures should not be discouraged if there is a relatively satisfactory chance of ultimate success, but I have not seen good results from extreme attempts to eradicate carcinoma of the rectum graded 4 and 3+. Fixation, which sometimes makes one feel that the local growth is inoperable, is, I feel confident, much oftener the result of inflammatory change than of malignant extension. For this reason I believe one should be willing to undertake difficult operative feats in low-grade carcinomata of the bowel.

Fortunately, the size of the growth means nothing as regards its grade of malignancy, and I am not at all sure that statistics would not prove that more rapidly growing and metastasizing growths are of comparatively smaller size than otherwise. Frequently, a carcinoma which is small, mobile, and apparently localized is found

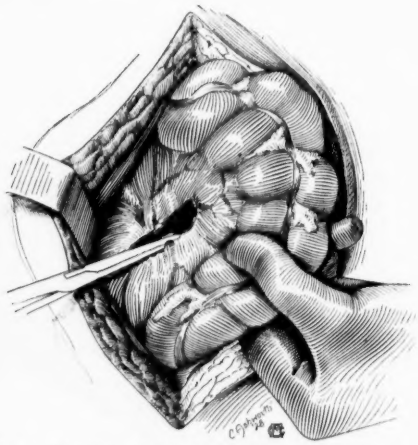

Fig. 5. Ligation of inferior mesenteric artery, a step readily carried out after identification of the vessel a little above the promontory of the sacrum. The vessel may be pinched off first to be sure that the blood supply to the proximal sigmoid is adequate. Sigmoidal branches should not be tied in the main ligature but the point of ligation is between the superior hæmorrhoidal and sigmoidal vessels.

to have invaded the lymph nodes and likewise to have caused hepatic implants. Far from discouraging radical surgical procedures where there is an opportunity for ultimate success, I believe by better understanding of the type of pathological change with which we are dealing we may increase sensibly the horizon of operability.

PRE-OPERATIVE MEASURES AND THE ANÆSTHETIC

Selection of types of operation, undoubtedly, if properly applied, enhances the chances of successful outcome, but operation, regardless of its type and application, is but a single step in eradication of the local malignant growth. Satisfactory pre-operative measures, and an anæsthetic which eliminates many untoward complications, increase to a high degree the chances for ultimate cure. To these measures must be added an operation compatible with no more than a reasonable risk of immediate mortality, but which, at the same time, eradicates widely not only the local malignant growth but the tissues and lymph nodes in immediate juxtaposition to it.

Pre-operative measures, under co-operative management, aim at: (1) rehabilitation of the patient's general resistance, which is usually undermined by the dehydration and anæmia incident to the malignant process, and (2) elimination of as much local infection as possible by medicaments or drainage.

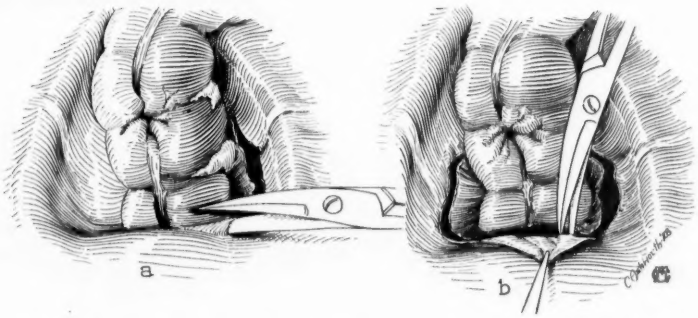

Fig. 6. Incision of the lateral parietal peritoneum. a, The ureter may be seen. Ureters should always be identified on both sides. b, Bowel is being separated from the bladder by division of the peritoneal attachment to that viscus.

Fig. 7. Hand dissection of the hollow of the sacrum following division of the bowel and ligation of its blood supply. After identification of both ureters and tying the blood supply, one finds a line of cleavage between the layers of peritoneum which closed the mesentery, and blunt finger dissection readily cleans out the hollow of the sacrum and can be carried forward, well down to the pelvic floor in an almost bloodless manner.

Institution of the injection of intraperitoneal vaccine as a routine has, I believe, proved of value. However, whether or not it is sufficiently valuable to warrant its continuance has yet to be determined.

Anæsthesia is another problem of vital importance to weakened patients who present a poor risk. My feeling is that spinal anæsthesia has proved of enormous advantage in my hands in dealing with carcinoma of the large bowel and rectum. Following the suggestion of Miles and others, I have employed it as a routine for 2 years in cases of carcinoma of the colon and rectum. Freedom from pulmonary complica-

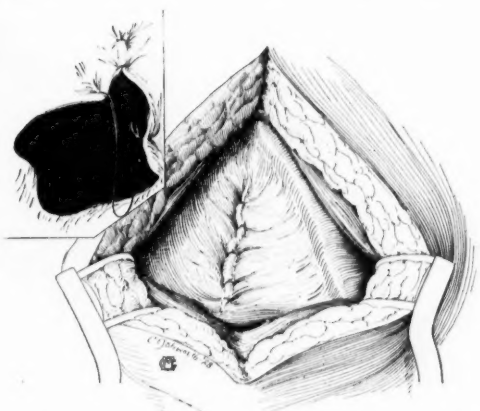

Fig. 8. Operation completed. Accurate peritonealization is shown; this really forms a new floor at the brim of the pelvis. Provision is made for saving adequate peritoneum during mobilization and previous steps of operation. There is always sufficient peritoneal covering for this step to be accomplished without difficulty.

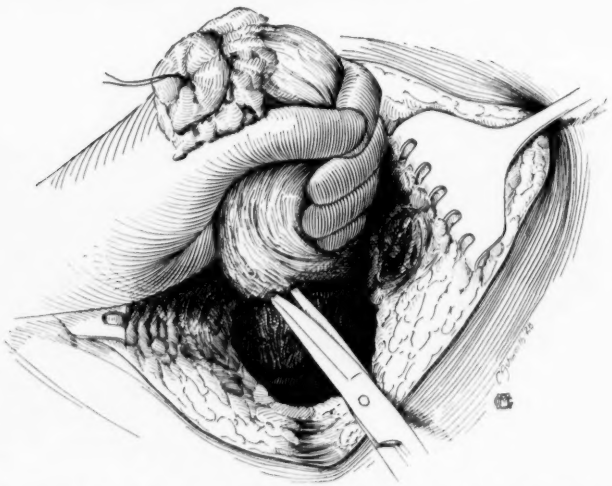

Fig. 9, left. Posterior incision for removal of segment of bowel to be sacrificed. This is identical with incision for usual posterior resection.

Fig. 10. Mobilization of lower part of rectum after completion of abdominal portion of operation. Here the bowel is shown being dissected away from the bladder. The seminal vesicles are shown in the bottom of the field. Steps of ordinary resection are carried out as though the first portion of the operation had not already been accomplished.

tions, increased ease of surgical approach, and better postoperative convalescence convince me that its continuance is highly desirable. The advantages and disadvantages of the different types of operation for carcinoma of the rectum and rectosigmoid I shall not discuss in detail but shall leave with the assertion that the principles of the operations described by Jones and Miles are unquestionably fundamental in dealing with malignant conditions in these sites. Block dissection of all the zones of lymph nodes draining the growth and, at the same time, wide removal of the growth represents the ideal operation in this situation. That its application must be accompanied by most rigid and common sense selection of cases and that there must be acceptance of a considerably higher immediate mortality rate than in gastric or pelvic surgery is indisputable. At the same time, the relatively high number of satisfactory five-year cures or of freedom from recurrence which follows extirpation of carcinoma of the rectum and rectosigmoid by any of the approved methods urges a more earnest effort to bring patients with these lesions to operation earlier and in better condition in order that the most radical type of surgery may be employed.

In a series of cases in 1927, I removed carcinoma of the rectosigmoid by an anterior type of resection, either in one stage or in multiple maneuvers. The immediate success and the experience gained convinced me that extension of this type of operation was applicable in many cases of rectal carcinoma; in fact, in the same type of rectal carcinoma in which Jones and Miles each urges his own individual procedure. The steps of the operation group themselves readily: (1) incision and exploration; (2) ligation of the blood supply and mobilization of the growth; (3) resection of the growth; (4) colostomy: obstructive colostomy and resection if the operation is to be done in one stage, or if the colostomy has already been accomplished 2 or 3 weeks previously and this is the second stage of the extirpation, removal of the distal stump; (5) peritonization of raw surfaces; (6) treatment of rectal stump: removal of the rectal stump or of the whole growth after closure of the abdominal incision and turning the patient over on his face, or if completion of the operation at this time is inadvisable and if the resection has been done in front, leaving a small rectal stump, institution of drainage by a stab wound between the anus and coccyx; (7) in the event that the posterior stump has been left and the other steps of the operation have been completed at one stage, removal of the posterior stump as a separate step 10 days later.

ONE-STAGE OPERATION

My practice in applying the abdominoperineal technique to carcinomata of the rectum is the

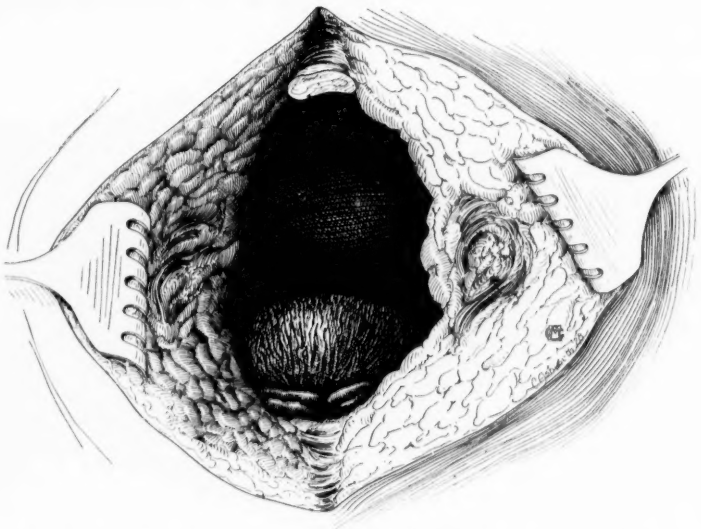

Fig. 11. Operation completed. The posterior side of the new perineal diaphragm, the base of the bladder, and seminal vesicles are shown.

Fig. 12. Closure of wound and drainage.

product of a gradual evolution from the anterior type of resection. This I had been able to carry out successfully in a large number of cases with low mortality because of improved pre-operative preparation and better selection of cases for this type of procedure. I found that in properly selected cases satisfactory removal of the growth at the first stage could be successfully undertaken in a great many instances. In case the colostomy was made at the time of exploration and it seemed inadvisable to carry on the operation for removal of the growth, the operation developed into a three-stage instead of a two-stage operation, as judgment dictated, with removal of the lower segment at the second operation or as a separate step still later.

Exploration through a low median-line incision is carried out and the liver is examined as the preliminary step, before palpation of the growth or viscera in its immediate vicinity is undertaken. I feel that this sequence is important and that the gloved hand should be introduced into the upper part of the abdominal cavity before being carried down into the pelvis where the infected carcinoma lies and from which organisms may be transmitted by direct contact to other portions of the peritoneal cavity.

If it is thought advisable to carry out the resection at the first stage, the operation is readily accomplished by the steps in the order already named. Preliminary ligation of the inferior mesenteric vessels a little above the promontory of the sacrum assures bloodlessness in the vast majority of instances during the subsequent stages of removal. Ligation of this vessel should be made above the superior hæmorrhoidal branch but below the sigmoidal branches, thus insuring adequate blood supply to the intestine at the colostomy opening. I have found it better to retract the bowel and mesentery to the left, to lift up the peritoneum and divide it, thus exposing the vessel, and to elevate it on a finger by blunt dissection before applying the ligatures. Double ligatures are applied and the vessel divided between them. An additional ligature is put on the proximal stump of the vessel, particularly if there is any amount of fat around the site of the first one, because of the tendency of vessels to retract in the fat and make for a subperitoneal hæmatoma.

At this point in the operation, the incision in the peritoneum on both sides of the mesentery of the bowel is carried forward to the bladder, and the ureter on either side is identified all the way from the brim of the pelvis to its entrance into the bladder. Following this the bowel is lifted, and, with a hand behind it, in the hollow of the sacrum, all the tissues, fat, and lymphatics in this neighborhood are dissected up by blunt dissection. The hand is carried downward and

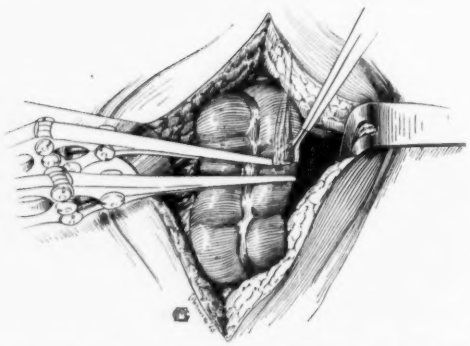

Fig. 13. Division by cautery of bowel between clamps. The distal end may be dropped down into the free peritoneal cavity while the proximal end is brought out through the incision after being closed, or the clamp may be left on, as the operator chooses.

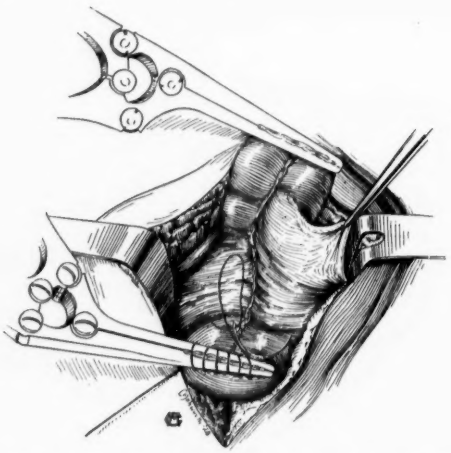

Fig. 14. The distal end of bowel being inverted with over-and-over suture, while the peritoneal attachment which runs from the mesentery to the sigmoid, off the lateral parietal peritoneum, is being held up taut.

forward until the dissecting fingers are felt to slide over the coccyx and down onto the floor of the perineum.

The lateral incisions are now extended forward and the peritoneal attachments holding the bowel to the bladder are divided with scissors. Here, further blunt dissection frees the bowel all the way around; and it is elevated until a point is reached that is well below the growth and where division of the rectum would leave a rectal stump of only 5 to 8 centimeters behind the division. Two clamps are placed on the bowel at this point and it is divided between them. With the bowel elevated, a place for colostomy is selected; this must be at a point where, by visual inspection, it can be seen that the blood supply will be sufficient to the proximal end of the severed intestine. Here the bowel is divided between clamps, permitting removal of the invaded segment and its lymphatics, fat, and adjacent tissues *en masse*. The proximal end, which is to remain as a colostomy, is now turned in with two layers of pursestring sutures. A hot pack, in the meantime, is placed in the pelvis to take care of any venous oozing which may be occurring there and a stab wound is made in the flank through which the stoma, made by the colostomy, is drawn. I have found it most satisfactory to make a stab wound which cuts directly through the muscle and fascia but which makes a very small hole in the peritoneum. When the proximal end of the cut intestine is pulled out through this small stab wound, the peritoneal coat fits snugly around it; but the other coats are loose and do not impinge on the lumen. Instead of placing sutures in the bowel, I have found it better to wrap it in gauze and permit healing to take place by granulation. The granulation around the colostomy opening is slow but the gauze pack is an advantageous guard against leakage when it is necessary to open the bowel at the end of 48 hours, as it rarely is. The rectal stump is now turned in, and decision is made as to whether or not it is desirable to do the operation in one stage or in two stages. The next important step is adequate peritonization of the pelvis covering over the raw surfaces and making a new peritoneal diaphragm, which is in reality a new pelvic floor several centimeters above its former site.

I have always found it possible to make satisfactory peritonization. Several times when the step was begun it looked as though it would be impossible, but with patience and sutures one can invariably cover the floor in a perfectly clean and satisfactory manner. The omentum is now brought down into the pelvis to keep the small bowel away from the site of operation as much as possible and the wound is closed and sealed off with collodion in an effort to keep it free from being subsequently infected.

The patient is now turned on the side or the face, as one chooses, and the operation is completed either by removal of the rectal stump or by the institution of drainage alongside it into the hollow of the sacrum. Drainage is usually satisfactorily accomplished by insertion of two small tubes of rubber tissue. If it has seemed wise to proceed with removal of the rectal stump in this

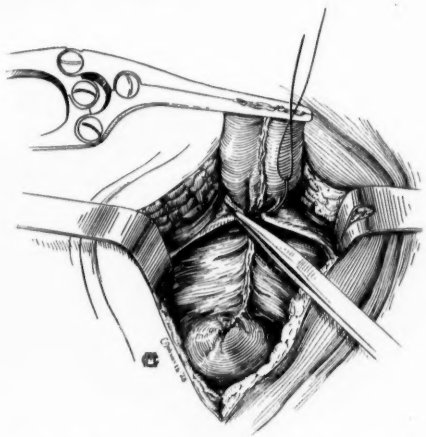

Fig. 15. Peritoneum is wrapped around the upper loop, on which the clamp is left.

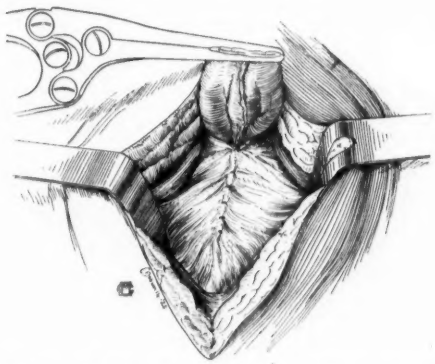

Fig. 16. Closure of wound, the proximal stump of bowel being left out and the peritoneum and other layers sutured around it.

same stage, a circular incision around the anus, similar to the incision used for posterior resection, is employed. It is not necessary to remove the coccyx. A catheter has previously been placed in the bladder and there is small danger of wounding the urethra. This excision of the rectal stump requires only 5 to 10 minutes if done at this stage, and, if left for a subsequent stage, 3 to 5 minutes. It is more easily accomplished at a later stage because of lack of bleeding at the second operation. After its wide mobilization at the second operation, it peels out very easily, once a line of cleavage is established. I feel confident that this type of drainage is more satisfactory than the one I formerly employed, namely, the method of bringing out drains through the abdominal wall and draining by way of the abdominal cavity. I have not had an unfortunate experience with closure of the cavity following this type of operation which would make me want to abandon it.

MULTIPLE STAGE OPERATION

Should it seem advisable, either before exploration or at exploration, that the malignant growth be removed by a graded procedure, the first step of which is colostomy, the operation is modified somewhat. However, the principles are carried out very much in detail as in the one stage procedure, with the exception of the type of colostomy employed and the time of removal of the lower segment. I have found two types of colostomy satisfactory in making a two stage or three stage resection by the combined abdominoperineal route. First, the ordinary type of colostomy by which a loop of bowel is brought out through a split muscle incision or through a stab wound in the left groin, the latter provided exploration has been made through a median line incision. This loop is brought out and allowed to remain as long as 7 or 8 days if the patient will stand discomfort that long. Gas passes through the loop if it is not made too tight, and it is not necessary to open it any time up to the third or fourth day and frequently not until the eighth or ninth day. Women stand the discomfort more readily than men; rarely does a colostomy loop have to be opened in the case of a woman in less than a week.

The point I wish to emphasize about this ordinary type of colostomy is the removal of the distal stump, which is a blind pouch, after resection of the sigmoid and rectum. This little stump, which is the end of the bowel below the division made at the time of the colostomy

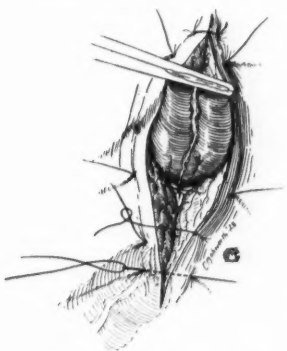

Fig. 17. Operation completed, wound being closed.

and which usually has been turned in with two or more layers of sutures, leaving a projection into the peritoneal cavity, should, I believe, always be removed, even at the expense of more operating and slight increase in risk. I form this conclusion from a case in which the patient died from perforation of this stump, as shown by postmortem examination; death was found to be due to general peritoneal contamination. Usually one can be relatively sure of the blood supply to this blind pocket, but since one cannot always be sure of this I am not willing to leave it in place because of the occasional danger of perforation. It is easily removed at the second stage of the operation by dividing the blood vessels close to the peritoneum and then by invaginating the loop through the abdominal wall, closing behind it with two mattress sutures. The small piece of bowel is then left adherent on the anterior abdominal wall for 3 or 4 days and then is removed by cautery; the peritoneum, in the meantime, has been sufficiently sealed off to prevent danger of contamination.

Another type of colostomy which I have found satisfactory in these cases is made by dividing the bowel at the time of exploration and turning in the distal end, whereas the proximal end is brought out and left. A single barreled colostomy is made in this proximal end when it is opened after 48 or 72 hours, as necessity demands. By dropping back the distal end of the loop of bowel into the peritoneal cavity, one has an opportunity still to irrigate the growth through rectal injections and thus to carry out the cleansing program which is advisable. At the same time the very satisfactory single portion of bowel which is allowed to project is left closed until necessity demands that it be opened. The length of bowel, in this single barreled colostomy, which should be allowed to project out of the abdomen is a question of which I am not entirely sure; but occasionally a very long, projecting portion will be found advantageous in that it may be allowed to hang free in a colostomy bag and make for ease in taking care of it. At the same time, a short portion, close to the skin, is readily taken care of by a tight fitting pneumatic colostomy apparatus. If colostomy is made through a stab wound, which is small and fits snugly around the bowel, hernia is much less common. I have seen a great many hernias develop in left rectus and even in split muscle colostomies as a result of long standing, continued pressure from colostomy apparatus. Of necessity, these devices must fit very tightly around the bowel and they vitiate the resistance of the abdominal wall, with the result that weakness and separation follow after months or a year of application. If the single barreled colostomy is used, one either may turn in the end of the proximal loop with a pursestring suture, which may be divided by cautery at the proper time, or one may simply leave a heavy clamp on the end. Either method is satisfactory and the subsequent steps of resection are identical with those described in the one stage operation. I have found that the distal end usually adheres snugly to the peritoneum, as one does not divide much blood supply in making a colostomy of this type and care must be taken in separating it from its attachment, or the ends may be opened inadvertently. In ligating the blood supply to this distal end, ligature must be placed close to the bowel until one is away from the immediate vicinity of the colostomy so as not to encroach on its nutrition. Having made the colostomy and waited a sufficiently long time, resection is undertaken through a low median line incision and is carried out as already described. If the growth is at the rectosigmoid juncture one may leave the short stump of rectum for drainage, posteriorly, subsequently removing the stump or not as seems wise. However, if the growth is in the rectum, resection should consist of complete removal of the segment below the colostomy and sufficient time should be permitted to elapse between the two stages of the operation to allow for recuperation and rehabilitation up to a point at which the patient is capable of standing a prolonged and difficult technical maneuver.

POSTOPERATIVE CARE

Postoperative attention following colonic resection is a necessity, contributing to shortening of hospitalization as well as to influencing in some degree the immediate prognosis. The cardinal feature of postoperative care is, I believe, satisfactory immobilization of the gastro-intestinal tract during the first few days. Spinal anæsthesia contributes splendidly by producing temporary paralysis over a varying period of time, occasionally as long as 48 hours. Morphine, necessary for pain, should be liberally used, since not only does it promote comfort but it likewise inhibits peristalsis. Total abstinence from food and drink is highly essential and should be insisted on until the fourth or probably the fifth day has been completed. I have found that when the patient begins to pass gas by the colostomy opening, or by rectum if the operation has been on the colon, provided the temperature and pulse rate are within reasonable limits, small harm is ever done by beginning the administration of small quan-

tities of fluid by mouth. Up until this time, however, the water balance is maintained by the administration of glucose and physiologic solution of sodium chloride intravenously, subcutaneously, or both. Drains are removed on the fifth day unless iodoform gauze packing has been instituted to control bleeding in case of complete operation in one stage. Should gauze be used, its removal is best left until the seventh to ninth day, since by that time it is usually saturated with secretions and may be readily removed without pain. In the event that it sticks to surrounding tissues, irrigation with physiologic solution of sodium chloride will loosen it and will permit its removal. The large cavity which contained the rectum must be filled in by granulation tissue. Subsequent treatment by irrigations, sitz baths, and other agents which permit rapid healing and increased comfort is given as a routine.

With adequate co-operative management, satisfactory pre-operative preparation, careful selection of cases for operation and of operation for individual cases, I am convinced that the abdominoperineal type of resection, either as a single or graded operation, is adaptable to an increasingly large percentage of cases.

A METHOD OF USING THE SAME VEIN REPEATEDLY FOR INTRAVENOUS MEDICATIONS

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BLOOD, saline, glucose, and other intravenous medications have become very important factors in the treatment of various medical and surgical conditions. It is often necessary to give these treatments daily and sometimes two and three times a day. Occasionally one finds patients who are so fat that the superficial veins can not be palpated or recognized and others who are in such severe shock that their veins are collapsed. In these patients it is nearly impossible to give repeated intravenous treatments without cutting down on to a vein.

Under these circumstances it is my custom to use the method which is clearly demonstrated by the accompanying drawings.

Figure 1 shows an incision made over one of the superficial veins, usually the medium basilic. A plain catgut suture is passed around the vein in the lower angle of the wound and the vein is tied off. Mosquito forceps are used and the vein is grasped just above the tie and a V-shaped incision is made between the ligature and the supporting forceps. It is advisable to use small sharp scissors for the incision of the vein.

Figure 2 shows the cut flap in the vein retracted upward and the cannula ready for insertion into the lumen of the vein. The solution is then allowed to run in.

Figure 3 shows a black silk suture placed through the skin and superficial fascia opposite

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1. Exposure of vein.
Fig. 2. The cut flap retracted upward. Cannula ready for insertion.

Fig. 3. Black silk suture placed through skin and superficial fascia opposite base of flap in vein; then under vein, to come out on other side of wound.

Fig. 4. Bow knot tied over vein and skin.

the base of the flap in the vein and then under the vein and to come out directly opposite on the other side of the wound. The cannula is removed and the mosquito clamp on the cut flap of the vein is retracted downward. The skin suture is tied approximating the skin edges over the incised vein tight enough to prevent backward leakage of blood from the vein.

Figure 4 shows a bow instead of a square knot tied over the vein and skin. When another intravenous treatment is necessary the bow knot is untied and the skin edges gently retracted, thus again exposing the vein. The V-shaped flap in the vein is again picked up by mosquito forceps, elevated, and the cannula reinserted into the vein.

Such a vein may be used innumerable times in this manner if the procedure is done correctly and without undue trauma. If the sides of the vein adhere, it is very easy to push the cannula gently through this obstruction.

There is but slight pain or discomfort connected with the procedure. The skin is infiltrated with novocain before the original incision is made, but no anæsthesia is needed for the repeated use of the vein. It is well to resterilize the operative field before and after each treatment.

OSTEOMYELITIS OF THE ISCHIUM AND PUBIS

A New Operative Technique and A Study of the Surgical Anatomy[1]

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ACUTE osteomyelitis of the ischium and pubis is difficult to diagnose before destruction of bone is evident by roentgen-ray examination or before an abscess has formed. This difficulty is due to the following facts: (1) osteomyelitis of these bones is infrequent; (2) the bones in question are rather inaccessible; and (3) the symptoms of osteomyelitis in these bones are similar to those of inflammation of the hip joint.

Early operative treatment is important in order to avoid sepsis, pyæmia, chronic osteomyelitis, and other complications. Surgical interference, including that for osteomyelitis, is rare in this region, which undoubtedly accounts for the fact that there is no recognized technique for operative exposure of the pubis or ischium.

The present study includes a report of 4 cases, with a description of the surgical anatomy of the pubis and ischium, and an original and satisfactory method of operation. The ischium was involved in all cases, with extension to the ramus of the pubis in one instance.

Case 1. Acute suppurative phlebitis of the left leg. Septicæmia. Acute suppurative osteomyelitis of the left tibia, the right pubis and ischium. Non-suppurative osteomyelitis of the left clavicle.

M. St. J., aged 11 years entered the Presbyterian Hospital March 18, 1928, complaining of pain and swelling of the left leg and ankle with fever which had been present for 2 days. There was no history of injury although she thought she might have twisted her ankle slightly in the gymnasium a few days previously. There was no pain until the ankle began to swell. One month previously she had suffered from an acute earache. A doctor at that time found a catarrhal otitis media but no rupture occurred. Since then she has not felt so well as usual. There was no history of any infectious disease. The tonsils and adenoids had been removed several years previously.

Examination disclosed the following: Temperature was 104.2 degrees. The left leg was swollen and œdematous over the medial and anterior side and this condition extended down over the ankle. There was pitting on pressure. Tenderness was present over the swollen area, but it was not localized over the tibia. Pain was marked on any movement of the leg. The inguinal glands were enlarged. The white blood count was 30,000. The urine contained a trace of albumin. The temperature was 105.4 degrees the following day. A roentgenogram of the tibia and ankle taken on the fourth day of illness was negative.

Operation was performed March 19, 1928. Exploratory aspiration of the ankle was negative. The saphenous vein was opened above the ankle and gross pus filled the lumen. It was opened again just below the knee, and while the walls were found œdematous, no gross pus or blood was present. There was no evidence of an abscess at any point involving the tibia. Smears and cultures of the pus from the vein showed a staphylococcus aureus. Microscopic examination of the vein near the ankle showed a polymorphonuclear leucocyte infiltration of the wall and a thrombus firmly attached to it.

After operation there was some improvement and the temperature became lower. Some fever persisted, however, for the next few weeks with little change. Blood cultures 2 days after operation showed a staphylococcus aureus. The upper incision on the leg healed while the lower incision became covered with granulations, but did not heal. Six weeks after the onset, the leg became swollen again. There was little change in the fever, and a pocket of pus opened at the side of the wound. During the fifth week, a swelling due to osteomyelitis developed over the medial end of the left clavicle. This varied in size several times during the next few weeks, but gradually subsided without suppuration. Pain developed in the right hip about 4 weeks after the onset of the symptoms in the left leg but with little change in the fever. The pain would become worse for about 2 days when the patient would have to stay in bed. It would gradually lessen and the patient would be able to walk around with a limp. After about 8 weeks the pain became worse and the thigh became quite flexed.

Patient again entered the hospital, June 21, 1928.

Examination at this time showed the right hip flexed about 40 degrees as a result of muscle spasm. Pain was felt on any motion of the hip. Tenderness was most marked over the inner side of the thigh about the origin of the adductor muscles. No tenderness was present posteriorly over the neck of the femur. There was some purulent discharge from two openings over the lower half of the left tibia. A roentgenogram showed areas of thickening and rarefaction of the inferior ramus of the right pubis and both rami of the ischium, with some new bone formation. The right obturator foramen was darker than the left, suggesting an abscess in this region (Fig. 1).

Operation upon the pubis and ischium was done on June 22, 1928. In order to approach the pubis and ischium, the adductor muscles on the medial aspect of the thigh were split. The external obturator muscle was seen to be bulging forward, and when its fibers were split, about an ounce of thick pus was found beneath it in the obturator fossa. The inferior rami of the pubis and ischium were exposed and several holes were drilled in the region of the honeycomb-like areas shown in the roentgenogram. A small rubber tube was kept in the wound for several weeks, for drainage and irrigation. A slight sinus persisted for several weeks after its removal but healing of the pubis and ischium was complete at 5 months. After operation, immediate relief was obtained from the pain and all movements of the hip became normal.

An operation was performed upon the chronic osteomyelitis of the tibia on August 14, 1928. Several sequestra were removed from the sides of the medullary canal. The involved area of the lower one-half of the tibia, which did not extend into the cancellous bone of the metaphysis, was saucerized. Ten months later, there was still a slight discharge from a narrow granulating area over the lower part of the tibia. The general health was excellent.

[1]Read before the Chicago Surgical Society, November 2, 1928.

CASE 2. Primary acute osteomyelitis of the ischium, followed by a non-suppurative ankylosing arthritis of the hip. Purulent tonsillitis.

J. S., male; aged 14 years. The chief complaints on entrance to the hospital were fever, pain, and tenderness around the hip. The onset was about 2 weeks ago with the development of severe pains in the left shoulder and the right wrist. These cleared up, but 2 days later, acute pain developed about the left hip, with a fever of 103 to 104 degrees for several days. Some relief was obtained by cold applications, but 5 days later, after an attempt to walk, the fever and the pain returned.

Examination disclosed a temperature of 101.6 degrees and a white blood count of 12,200. Any attempted movement of the left hip produced muscle spasm and pain. Tenderness was more marked medial to the thigh, in the groin, and anteriorly over the joint. Some deep tenderness was present along the left side of the abdomen in the region of the iliopsoas muscle. No evident tenderness could be found over the neck of the femur posteriorly.

A roentgenogram about 12 days after the onset showed areas of rarefaction and destruction in the superior ramus of the ischium (Fig. 2), with some new bone formation along the outer border. The patient appeared quite toxic with a high remittent fever. After 2 days of observation, operation with drainage of the ischium seemed indicated.

The ischium was operated upon by the method of splitting the adductor muscles on the medial aspect of the thigh. The obturator fascia and muscle were split and the outer surfaces of the rami of the ischium and pubis were exposed, but no abscess was found. The obturator membrane was then opened and the inner surfaces were explored. Multiple drill holes were made in the region of the superior ramus of the ischium, which showed changes in the roentgenogram. No gross pus was seen, but an iodoform gauze drain was inserted. The toxæmia subsided promptly and the temperature became normal within a week. The drain was removed after a few days, and the patient was able to move the hip for the first time, without pain. At the end of 14 days he was sent home with no complaints.

The patient re-entered the hospital 2 months later, complaining of difficulty in using the left leg in walking. There was no pain at this time. He stated that shortly after returning home, he had developed a severe pain in the left hip, radiating to the knee. This lasted several days but gradually improved without treatment. Since then, he has been unable to straighten the thigh at the hip, and walking has become difficult.

Examination at this time showed the left thigh flexed to an angle of about 45 degrees and slightly abducted. The hip joint seemed firmly fixed, but there was no pain or tenderness. The muscles of the left thigh and leg were moderately atrophied from disuse. The knee was normal. At this time a large amount of free pus was expressed from the right tonsil which was larger than the left, and slightly reddened. There were no complaints of sore throat.

Roentgenograms showed an extension of the destructive process, previously seen in the ramus of the ischium, into the acetabulum and the head of the femur. The joint space was almost completely obliterated due evidently to destruction of the joint cartilage. There was no evidence of bony fusion.

The patient was anæsthetized and considerable force was necessary to correct the flexion deformity of the hip. A plaster-of-paris cast was applied to the body and leg and was worn for 2 months. After removal of the cast, walking was much improved. No symptoms of inflammation followed the manipulation or occurred during the subsequent 3 months.

CASE 3. Acute osteomyelitis of the superior ramus of the ischium with abscess. Chronic abscess in the thorax.

Female, age 44 years. The illness began about 3 months previously following a cold. It started with vague pains in the chest, a fever, and a persistent cough. There was no sputum and no history of previous symptoms. The family history was negative for tuberculosis. The past history was negative except for a fall one year ago with a fracture of the necks of both femurs. Since then, she has walked with crutches.

During the past month, the patient has become toxic and mentally sluggish. A swelling suddenly appeared over the ischium, and there was an increase in fever and toxæmia. The white blood count was 35,000. The swelling was incised near the tuberosity, and a large amount of pus was evacuated. A roentgenogram was taken about a week later and showed a sharply demarcated area of bone destruction in the superior ramus of the ischium near the greater tuberosity, with no evidence of new bone formation (Fig. 3). There was dullness beneath the right scapula. A roentgenogram of the chest showed on the right side a walled-off pulmonary abscess. It was thought wise not to explore this abscess at that time, due to her poor condition. The Wassermann and the urine analyses were negative. The large deep wound over the ischium drained until death, which occurred 2 or 3 weeks later, while the patient was still in a septic condition.

CASE 4. Acute osteomyelitis of the neck of the right femur. Chronic osteomyelitis of nine years' duration with sequestrum of the inferior ramus of the left ischium. Multiple old healed areas of osteomyelitis.

J. H., male, aged 17 years, came into the hospital with a high fever, toxæmia, and symptoms of an acute osteomyelitis of the neck of the femur, which I operated upon and drained. This was followed by a long convalescence.

There was a history of multiple osteomyelitis 9 years previously. At that time, throughout a year, he had multiple foci involving the hands, arms, ribs, legs, and the right hip with abscess formation. In one of these attacks, an abscess ruptured on the right side of the perineum, and, except for occasional temporary closing, he has had a sinus there ever since. Roentgenograms taken of the pelvis, at this examination (Fig. 4), showed a chronic osteomyelitis of the left ischium in the region of a small external sinus which was draining pus. A spherical area of dense bone resembling a sequestrum was noted in the inferior ramus of the ischium, with a narrowed ring of lessened density resembling a bone cavity around it. Several somewhat irregular areas of new bone formation were seen along the borders of the ischium. The head of the femur on this side presented a mushroom-like appearance with considerable bone hypertrophy and proliferation at its base. There were no previous symptoms or history of involvement of this left hip during the attacks of osteomyelitis. The changes were possibly secondary to the extension of the infection years ago from the osteomyelitis of the rami of the ischium. There was evident tilting downward of the pelvis on the right side, but no X-ray evidence of the acute osteomyelitis of the neck of the femur.

Nothing was done at this time to relieve the chronic osteomyelitis of the ischium because of the acute process in the neck of the right femur, which was operated upon.

ETIOLOGY

Hæmatogenous osteomyelitis of either the pubis or the ischium is relatively infrequent as compared with the occurrence of the condition in the ilium or the long bones. Klemm noted involve-

ment of the ischium and pubis each two times in 385 separate lesions of osteomyelitis in 320 children. Lloyd in 29 cases of osteomyelitis reported 2 cases with involvement of both the pubis and ischium. Ogilvie in 51 cases reported involvement of the pubis in one case. Platt in 41 cases of osteomyelitis found no involvement of pubis or ischium, although the ilium was involved in 4 cases.

Doran and Brown noted that there was a chronic osteomyelitis of the ischium in 3 out of 71 cases of osteomyelitis in childhood. They, Ogilvie, and others have observed that a recent furunculosis, tonsillitis, or otitis media often appeared to be the primary infection in osteomyelitis. A history of local trauma was also common. Raeschke described an osteomyelitis of the pubis following measles.

In the writer's 4 cases there were 2 boys and 1 girl, 9 to 14 years of age, and one woman aged 44 years. Multiple foci of infection developed in all cases. In Case 1, there had been a catarrhal pharyngitis and otitis media one month previously. The onset was associated with a suppurative thrombophlebitis. This may have extended to or from the osteomyelitis of the tibia. The right pubis, ischium, and clavicle developed infection several weeks after the onset. A staphylococcus aureus was obtained shortly after the onset, from blood cultures from the phlebitis over the tibia, and later from the abscess resulting from the osteomyelitis of the pubis and ischium and also from the tibia.

Ogilvie stated that in all London Hospitals the staphylococcus was the cause of osteomyelitis in 90 per cent of all cases while the pneumococcus and other bacteria were rarely found.

The osteomyelitis of the ischium in Case 2 probably resulted from a tonsillitis. The osteomyelitis of the ischium in Case 3 probably resulted from an encapsulated abscess in the thorax of 2 months' duration. In Case 4, the osteomyelitis of the ischium occurred 9 years previously, following multiple foci of osteomyelitis all over the body. There resulted only the chronic osteomyelitis of the ischium with a sinus which may have been the source of the present acute osteomyelitis of the femur.

PATHOLOGY

In Case 1, both rami of the ischium and the inferior ramus of the pubis were involved (Fig. 1). Osteomyelitis involving the body of the pubic bone was observed by Phemister in a patient with an abscess forming within the pelvis and following downward along the rectum to point externally.

The associated osteomyelitis of the tibia in Case 1 involved the lower one-half of the shaft beneath the phlebitis but with no involvement of the metaphysis. This lends support to the possible origin from a retrograde suppurative phlebitis. Platt stated that while the metaphysis was nearly always the site of osteomyelitis, in older children the infection may reach the shaft of a long bone by the nutrient artery and develop near the middle of the shaft spreading toward the ends.

In Case 2, the superior ramus of the ischium was involved (Fig. 2) with later extension to the body of the ischium including the hip joint and destruction of the articular cartilage without abscess. The clinical picture of this extension of the disease to the hip and the roentgenological changes resembled very closely the type of acute non-suppurative ankylosing arthritis described by Stern.

In Case 3 the roentgenogram showed an area of bone destruction near the tuberosity of the ischium (Fig. 3).

In Case 4, there was a chronic sinus and the roentgenogram showed a sequestrum surrounded by a cavity in the inferior ramus of the ischium, and proliferative changes along the ramus. The other old osteomyelitic foci were healed. Raeschke stated that in flat bones sequestra are frequently absent because of the spongy structure of the bone. He observed in the roentgenogram periosteal thickening after 11 days and irregular destruction after 24 days.

The roentgenogram in Case 4 showed an old extensive hypertrophy of the margins of the head of the femur on the side of the chronic osteomyelitis of the ischium which gave it a mushroom-like appearance. No interference with hip function was observed.

The spread of osteomyelitis may be explained according to Starr by the subperiosteal extension of infection with secondary invasion of the shaft through the Haversian canals.

The associated bacteriæmia and toxæmia may prove fatal in the fulminating types before the development of gross suppuration in the bone, although infection is present and drainage indicated.

SYMPTOMS

The onset of osteomyelitis in the ischium developed subacutely in Case 1, following other foci of osteomyelitis. The onset was associated with a recurrence of high fever and toxæmia in Case 2, following a recent attack with pains in the bones of the arms. An abscess of the ischium developed in Case 3 with acute symptoms and an

aggravation of a toxæmia resulting from an abscess in the chest.

The course was subacute in Case 1 with repeated acute exacerbations of pain and disability lasting for a few days and gradually becoming worse. In Case 2, acute symptoms recurred, following an attempt to walk, after a quiescent period of 3 weeks, and the infection extended to the hip joint.

The local symptoms during the acute period were pain, deformity, muscle spasm, swelling, and tenderness anterior and medial to the hip. Pain was complained of in the region of the hip in acute attacks and in one patient referred along the thigh to the knee. Movement was limited in all directions by muscle spasm, and pain was felt on any movement in all acute cases, especially when the leg was extended.

Swelling was observed only with an abscess.

Local tenderness was always present medially in the thigh over the rami involved. Some tenderness was also present anteriorly over the hip. Pelvic tenderness may be determined by rectal examination. In Case 2, abdominal tenderness was present in the region of the iliopsoas muscle. No tenderness was felt on pressure over the neck of the femur posteriorly or over the great trochanter.

There was flexion deformity of the thigh to about 40 degrees in the acute cases. If an attempt was made to extend the thigh when the patient lay upon his back, a definite downward tilting of that side of the pelvis was produced. This was evident in the roentgenograms, the shadows of the rami of the pubis and ischium overlapping on the affected side so that it was necessary to retake the picture with the X-ray tube farther down in order to show the obturator foramen and the rami. This tilting of the pelvis was also present in Case 4 on the side opposite the chronic osteomyelitis of the ischium and was caused by the acute osteomyelitis of the neck of the femur.

The increased density in the obturator foramen on the side of the osteomyelitis in Case 1 was due to an abscess (Fig. 1).

The earliest roentgenogram was taken 12 days following the onset, in Case 2, and several weeks after the onset in Case 1.

An abscess arising from an osteomyelitis of the pubis or ischium and pointing in the region of the ischiorectal fossa may be mistaken for a rectal abscess or a cold abscess arising from the pelvic bones. A chronic osteomyelitis may be diagnosed by means of a roentgenogram and, if necessary, by the injection of the sinus.

Acute inflammatory rheumatism is usually associated with multiple involvement, swelling, greater tenderness, and muscle spasm. Early acute osteomyelitis of the neck of the femur may have similar constitutional symptoms, but the deep tenderness posteriorly over the neck of the femur is characteristic, and early muscle spasm and pain on movement are not so marked. With a suppurative arthritis, the local symptoms and swelling usually predominate. Raeschke, however, did an exploratory aspiration of the hip in his case of osteomyelitis of the pubis.

PROGNOSIS

The mortality rate in osteomyelitis of the pubis and ischium is difficult to determine from a small series of cases. In 10 cases including the 4 reported by the author, 1 reported by Raeschke, 3 by Doran and Brown, and 2 by Lloyd, only 1 died, a mortality of 10 per cent. However, 4 of these were seen when chronic and the outcome is not known.

The mortality rate is high in acute hæmatogenous osteomyelitis of all bones. Doran and Brown reported 8 deaths in 42 cases, or 19 per cent. Ogilvie reported 11 deaths in 51 cases, or 21 per cent, but a mortality of 33 per cent in the cases of osteomyelitis of the ilium. Platt stated that the mortality of osteomyelitis of the flat bones, especially the ilium, is very high, but this is due to the fact that the infection here is very severe.

Lloyd stated that there was a higher mortality from the staphylococcus aureus than from the staphylococcus albus, the streptococcus, or the pneumococcus. It would seem that the mortality from osteomyelitis of the pubis and ischium is lower than in other bones and considerably less than that of the ilium.

After drainage of the abscess in Case 1 the inflammatory symptoms subsided, and perfect function of the hip and thigh promptly resulted. Healing of the sinus occurred after 5 months. Inflammation extended to the hip joint in Case 2 and old changes were evident in Case 4. Case 3, with a pulmonary abscess, developed toxæmia, osteomyelitis, and died. Case 4, with chronic osteomyelitis of the ischium of 8 years' duration, developed an acute osteomyelitis of the right femur.

TREATMENT

Early operation with drainage is essential in osteomyelitis of the ischium and pubis. The treatment of suppurative osteomyelitis by subperiosteal incisions and multiple drill holes as advocated by Starr is based upon the fact that

Fig. 1. Roentgenogram of Case 1 before operation. Areas of rarefaction and increased density were present in both rami of the ischium and in the inferior ramus of the pubis, with some proliferative changes.

The increased density of the right obturator foramen was due to an abscess.

the localization of the infection is usually in the metaphysis and that it spreads subperiosteally. This method may be effective early and is less serious than more destructive procedures. Even though a small focus is not directly tapped, the drill holes in the cortex offer relief of tension and may prevent massive bone necrosis. Platt prefers a small trephine opening for early drainage.

In doubtful cases, there is little risk in early exploratory operation or even drainage under good conditions before changes may be detected by the roentgen-ray. This makes it important to know the usual location of osteomyelitis of the ischium and pubis.

In the fulminating types, or during an acute toxæmia, with a generalized infection, general supporting measures are indicated and delay in operation may be advisable.

The application of a plaster-of-paris cast completely limiting all motion has been emphasized by Orr in the treatment of osteomyelitis. I believe that this should be done, especially if the osteomyelitis of the ischium or pubis approaches the joint. Weight extension with suspension of the limb may be useful in early cases.

Stern has found immobilization useful in the treatment of acute non-suppurative ankylosing arthritis of the hip associated with destruction of the articular cartilage and obliteration of the joint space. Similar joint changes developed in Case 2. In this instance, a flexion deformity of several weeks' duration was largely corrected under an anæsthetic, with improvement following the application of a cast.

Fig. 2. Roentgenogram of Case 2 before operation. Areas of rarefaction were present in the inferior ramus of the left ischium with a zone of new bone formation externally. The hip joint was normal at that time.

Raeschke saucerized a small cavity filled with granulation tissue in the inferior ramus of the pubis and the patient recovered.

Operative exposure of both the pubis and ischium is desirable because drainage should be established before roentgenological changes occur. An abscess will usually be directed to the space beneath the external obturator muscle, beneath the internal obturator, or into the ischiorectal fossa. A posterior surgical approach to the ischium either from within or without offers insurmountable objections. An approach between the tuberosity of the ischium and the hip joint may endanger the sciatic nerve with its branches and the numerous short muscles to the femur. The thick gluteus maximus would also make it more difficult. Occasionally, an abscess may point posteriorly and an exploratory aspiration or simple drainage may be accomplished by this route.

A surgical approach to the ischium through the ischiorectal fossa is objectionable because of the presence of the fibrous sheath forming Alcock's canal, the contents of which, the internal pubic nerve and artery, extend from behind the spine of the ischium forward on the medial surface of the tuberosity and then along the inferior ramus of the ischium. In Case 4, an abscess pointed in the ischiorectal fossa and was incised.

Fig. 3. Roentgenogram of Case 3. A sharply outlined area of bone destruction is shown near the tuberosity of the ischium.

Fig. 4. Roentgenogram of chronic osteomyelitis of the inferior ramus of the ischium. A spherical dense shadow resembling a sequestrum was surrounded by a cavity. Old hypertrophic changes are seen in the head of the femur.

A perineal approach with exposure of the inner side of the inferior ramus of the pubis through the urogenital structures with their blood vessels and nerves is practically impossible. An anterior approach through the groin to the superior ramus of the pubis would be unsatisfactory because it would expose only a small area and might also endanger important fascial structures about inguinal canal or blood vessels and nerves to the thigh.

Any of these routes of surgical approach to the pubis and ischium would result in a difficult and dangerous operation with a limited exposure of the rami and would offer no chance for exploration or drainage of the bodies of these bones.

A satisfactory method of approach through the split adductor muscles was originated after a study of the surgical anatomy on the cadaver (Fig. 5) and was used in Cases 1 and 2.

SURGICAL ANATOMY

The adductor longus tendon arises from the ramus of the pubis just below and medial to the tubercle, and the muscle broadens out to extend laterally and toward the shaft of the femur.

The adductor brevis arises beneath the longus and the gracilis with the lower end arising between the gracilis and the adductor minimus. The two edges of the brevis parallel rather closely the upper and lower borders of the symphysis pubis. The adductor brevis then spreads out in a broad thick band extending a little below the adductor longus but is completely covered by the gracilis muscle.

The adductor minimus has a longer origin than the other adductors but is somewhat thinner. Its anterior edge arises from beneath the border of the brevis and the middle of the gracilis, and its posterior edge, beneath the adductor magnus not far from the tuberosity. The muscle belly passes rather suddenly underneath the adductor brevis and the magnus, due to the rapid convergence of these muscles.

The adductor magnus muscle has a broad attachment to the ischium, which extends from the region of the tuberosity to occupy two-thirds of the distance to the gracilis and overlaps the adductor minimus.

The fascial origin of the adductor muscles is chiefly along a bony ridge from near the tubercle of the pubis to the tuberosity of the ischium. The ridge forms about one-third of the outer surface of the intervening rami, where it stops abruptly in a sharp crest, which forms the origin of the strong external obturator fascia. The remaining two-thirds of the outer surfaces of these rami are largely covered by the external obturator muscle fibers which are loosely attached to the bone.

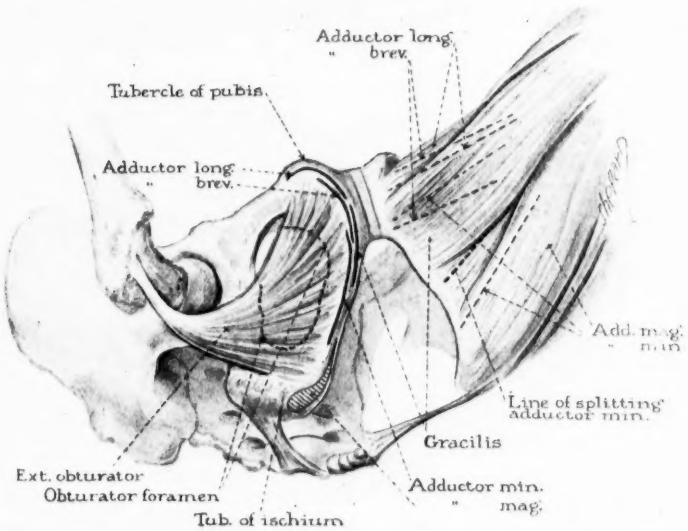

Fig. 5. Drawing made from dissections on the cadaver in the lithotomy position, showing the origin and the relation of the adductor muscles.

The external boundary of the obturator fossa is formed by the external obturator muscle, the fascial origin of which extends well out on the rami and almost to the pubic tubercle. There is a large potential space the boundaries of which would be, medially, a large part of the adductor group of muscles; anteriorly, the pectineus; posteriorly, the quadratus femoris; while the base would be formed by the external obturator muscle. An abscess in this space might point anteriorly, along the insertion of the iliopsoas muscle; medially, through the adductors; or, posteriorly, into the ischiorectal fossa.

The obturator fossa contains some fat and is largely external to the foramen. However, the space also extends within the obturator foramen to surround a considerable part of the inner surfaces of both rami of the pubis and ischium. This inward extension of the fossa is the result of the origin of the obturator membrane from the inner surfaces of the rami some distance back from the margins of the obturator foramen, especially below

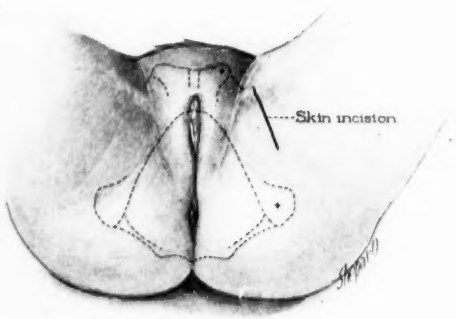

Fig. 6A. Drawing to illustrate the incision which is made in original method of operation upon either the pubis or ischium.

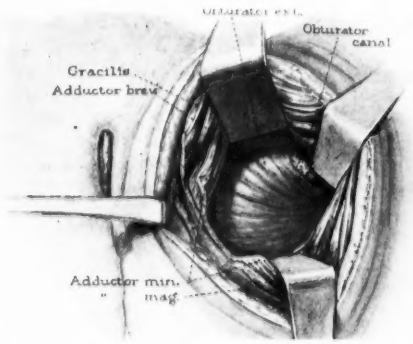

Fig. 6B. Splitting the adductor minimus muscle provides a satisfactory approach. The external obturator muscle may then be split to expose the pubis or ischium.

and posteriorly. Since the majority of the rami of the pubis and ischium is surrounded by the obturator fossa, an osteomyelitis would usually form an abscess here. Drainage may easily be obtained through the adductor route of operation.

The internal pelvic space is beneath the dense obturator membrane within the pelvis and is covered largely by the internal obturator muscle and its fascia. An abscess forming here would probably follow down along the rectum. Access to this space may also be obtained through the adductor route of approach. After the obturator fossa is entered, the obturator membrane is split and one may then explore practically all of the inner surfaces of the rami and bodies of the pubis or ischium and if necessary, provide drainage.

The obturator nerve and blood vessels pass out through the obturator canal in the uppermost distal part of the foramen, which will usually permit them to be avoided.

The surgical approach through the medial side of the thigh by splitting the adductor muscles is satisfactory. This opens up a large anatomical space permitting exposure and drainage of practically all parts of both the pubis and ischium.

TECHNIQUE OF OPERATION

The patient is placed in the lithotomy position (Fig. 6A). The gracilis muscle may be seen to form a taut broad band along the anterior border of the medial side of the thigh, while the adductor magnus muscle forms a band along the posterior border. The pubic tubercle and the tuberosity of the ischium are noted and an imaginary line between them may be seen to pass slightly below the origin of the adductor muscles of the thigh.

A transverse incision is made through the skin in the thigh along this line, extending from the middle of the gracilis to the middle of the adductor magnus muscle. The location of the skin incision some distance from the perineum helps to avoid contamination and also permits wider retraction of the gracilis and of the adductor muscles.

The broad but rather thin belly of the adductor minimus muscle should be split at about the middle of the distance between the gracilis and adductor magnus muscles (Fig. 5). This gives entrance to a large anatomical space with the external obturator muscle as its base (Fig. 6B). In order to obtain better exposure one may push aside or cut a part of the adductor minimus origin. A part of the gracilis and adductor magnus muscles might also be cut, but it has not been found necessary.

By the splitting of the external obturator fascia and muscle fibers, which cover a large part of the rami of the pubis and ischium, the obturator fossa may be entered and the two bones examined or operated upon. If desired, the obturator membrane may be incised and the interior surfaces explored.

Perforation of an osteomyelitis may occasionally occur along the edges of the rami and cause an abscess pointing in the perineum, the groin, or the ischiorectal fossa. Exploratory aspiration may be done followed by an incision over the point of the greatest swelling.

SUMMARY

1. Fairly characteristic symptoms and pathological changes are present in osteomyelitis of the pubis and ischium.

2. A knowledge of surgical anatomy in this region is important.

3. An original operative technique is described, which has proved satisfactory upon both the os pubis and ischium.

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INTESTINAL LOCALIZATION

A Review of Certain Studies (on the Cadaver) in the Surgical Anatomy of the Small Intestine and its Mesentery

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FOREWORD

THE subject of intestinal localization is an exceedingly important one. When the abdomen is opened because of acute conditions, the surgeon should know as quickly as possible, with minimal handling of the intestinal tract, the situation of the presenting small intestine as well as the direction of the intestinal current.

Having in mind the various articles[1] written on intestinal localization by Dr. George H. Monks several years ago, and the paucity of the literature on this subject since that time, I asked Dr. Monks if he would favor the readers of Surgery, Gynecology and Obstetrics with an editorial on intestinal localization. On second thought, however, it was apparent that so brief a space would be entirely inadequate to cover the field, and I therefore suggested to him that he embody the material in a more comprehensive form so as to give others the benefit of his contributions, which I have learned by experience to value highly.

William J. Mayo.

BY the expression "intestinal localization" is meant the determination on the part of the surgeon, in certain abdominal operations, as to what part of the intestinal tube any given loop of it occupies (i.e. its "position"); and, incidentally, as to which end of the loop is nearest to the duodenum, and which to the ileocæcal valve (i.e. its "direction"). This has reference only to that part of the small intestine which has a mesentery (viz., the jejuno-ileum); and also, of course, only to those loops which are not so near to the duodenum or to the cæcum as at once to make evident their position and direction because of their close connection with one or the other of these structures.

In most abdominal operations the surgeon has no special interest in the small intestine, except to withdraw it as soon as possible from the field of operation; and this he proceeds to do at once either by retraction or by gauze packing. However, there must occasionally be cases, especially those in which the intestine itself is to be the object of investigation or operative attack, in which help of this kind is of value; as for instance, in cases of obstruction from any cause or in connection with supposed perforation (pathological or traumatic), in anastomosis operations, in enterostomy where a fistula is to be made, or in cases in which the intestine itself is taken as a guide to one end or the other.

To be sure, all surgeons are familiar in a general way with the characteristics of the small intestine, and they also know what positions its different parts usually occupy in the abdominal cavity. Inasmuch, however, as no systematic study had been made, so far as I knew, with the object of enabling the surgeon to localize a loop of intestine in an abdominal wound, I made (about 25 years ago) a series of such studies on the cadaver; and these formed the basis of the published articles already referred to.

The intestine and its mesentery in a number of cadavers were first examined as a whole, their relations to one another and to the adjacent parts of the body being especially noted; and, finally, their different parts were inspected in detail. The value of the information thus acquired, together with that taken from textbooks and from other sources, was then tested through various abdominal incisions in other cadavers. The number of cadavers used for both of these purposes was about forty.[2]

[1] "Intestinal Localization," Ann. Surg., 1903, Oct.; "Studies in the Surgical Anatomy of the Small Intestine and Its Mesentery," Ann. Surg., 1905, Oct.; and "Intestinal Localization," J. Am. M. Ass., 1909, April 3, p. 1079. The text in the present article differs somewhat from that used in the original articles, but the illustrations are reproductions from the originals, their appearance here being kindly permitted by the *Journal of the American Medical Association* and also by the J. B. Lippincott Company, publishers of the *Annals of Surgery*.

As the original drawings and the blocks are no longer available, photographs were made from the printed illustrations, and these were then reinforced by Mr. H. F. Aitken, anatomical draughtsman at the Harvard Medical School. In this manner many of the original illustrations have been reproduced.

[2] Most of the cadaver studies referred to were made at the Harvard Medical School, a large amount of material being placed at my disposal through the courtesy of Dr. Thomas Dwight, (then) professor of anatomy, and of Dr. Charles B. Porter, (then) professor of surgery. Much assistance in this particular was also kindly given to me by Dr. F. B. Mallory, of the Boston City Hospital. To Professor Dwight I am also indebted for his calling my attention to the arrangement and variations of the blood vessels in the different parts of the mesentery. (See an article on this subject published by him in the Reports of the Meetings of the Association of American Anatomists, 1897.)

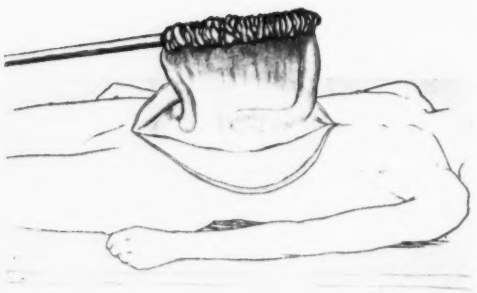

Fig. 1. The small intestine is puckered upon a rod. It is surprising with what ease this can be accomplished. The rod cannot be pushed into the bowel, but the bowel can be drawn, loop by loop, over the end of the rod and "puckered" upon it, so that the various loops become packed together. In some later experiments occasionally a tube was used instead of a rod. (Drawn from a photograph.)

TESTS AS TO POSITION

Many tests were made through a number of differently placed abdominal incisions in 16 cadavers. Through each wound one or more intestinal loops was pulled out and the characteristics were noted. They were then tagged and dropped back into the abdominal cavity. On each tag was recorded the estimated distance downward from the duodenum (or upward from the ileocæcal valve), that is, its supposed position. Incidentally, in many cases, opinion as to the direction of the loop was also recorded by a safety pin fastened to the wall of the gut, the point of the pin indicating the supposed direction toward the ileocæcal valve.

Later, the abdominal cavity was laid open from the ensiform cartilage to the symphysis pubis, and the actual distances of the different tags from the end of the duodenum (or from the ileocæcal valve, as it might be) determined by measurement; and a record, registering the exact amount of error as to position, was at once made. Record was also made as to the correctness, or incorrectness, of the supposed direction.

One hundred and eighty different localizations as to position were made in all. These localizations, however, were made on only about 125 different loops, as my assistant and myself frequently localized the same loop, independently of each other; such localizations on the same loop being recorded as 2. According to the tables prepared at that time, about 75 per cent of all localizations as to position were made with errors of less than 3 feet, the average error in the 180 tests being a little over 2 feet. Actual measurements, that is, the actual distances from the end of the duodenum (or from the ileocæcal valve) to the various loops under consideration, were used for record in these tests, as being best adapted for the purpose of comparing results; although, in practical work, it would probably be sufficiently accurate to speak of a loop as being, let us say, in a stated part of the upper, middle, or lower thirds of the intestine.

TESTS AS TO DIRECTION

Tests to determine the direction of the intestine were made on 90 intestinal loops in 15 different cadavers. In 82 (or 91 per cent) the estimated direction proved to be correct, in 8 it was incorrect. It is only fair to say that the errors both as to position and direction were more frequent in the early tests than in the later ones.

Although all these studies were made upon the cadaver the correctness of many of the observations recorded at that time was, by chance, later confirmed on the living subject.

THE SMALL INTESTINE AND ITS MESENTERY AS A WHOLE

Before going into details concerning the different characteristics of the jejuno-ileum and its mesentery, it would seem best to demonstrate these structures as a whole in such manner that one can best appreciate their general shape and their relations to one another and to the posterior wall of the abdominal cavity in which they lie and from which the root of the mesentery arises.

It has always seemed to me that the most effective way in which to make such a demonstration is to suspend the entire small intestine, with its attached mesentery, well above the abdominal cavity, thus temporarily emptying that cavity, so far, at least, as the small intestine and its mesentery are concerned. This can be accomplished on the cadaver (after the omentum has been raised up) in a number of different ways, the first of which being that shown in Figure 1, in which the whole of the small intestine (gathered upon a rod or dowel, and elevated well above the abdominal cavity, and carrying with it the attached mesentery) is made to conform to a straight line. The rod has been introduced into the gut through a small opening about 6 to 8 inches above the ileocæcal valve, and the entire small intestine, barring the upper and lower few inches, is drawn over its tip and puckered upon the rod. Two temporary ligatures are then placed on the ends, and it is found that, without using undue force, the 21 feet of intestine, more or less, can be made

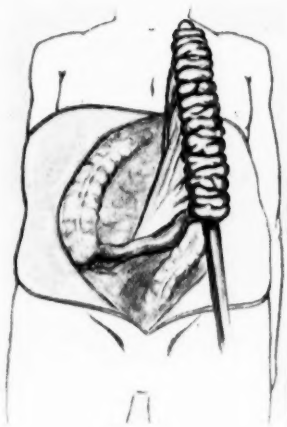

Fig. 2.

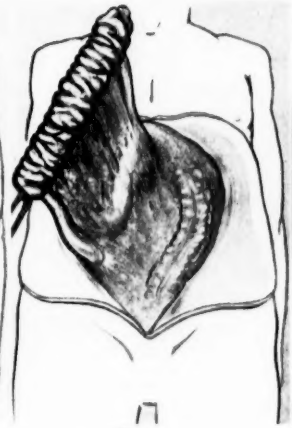

Fig. 3.

Fig. 4.

Fig. 2. The right fossa of abdominal cavity and oblique attachment of mesentery. (Drawn from a photograph.)

Fig. 3. The left fossa of abdominal cavity and oblique attachment of mesentery. (Drawn from a photograph.)

Fig. 4. The elevation of all the coils of the small intestine upon an instrument especially designed for this purpose.

to occupy a space of not much more than one foot in length. (Fig. 1.)[1]

When the intestine, held in this manner upon a rod, is so placed that the axis of the rod is parallel with the oblique axis of the mesenteric root, the entire mesentery may be inspected with great ease. Looked at in this way, it forms a sort of partition, as it were, with the puckered intestine fringing its upper edge. It thus divides the abdominal cavity into two large fossæ, of which the left is much the larger. By moving the rod toward the left side of the abdominal cavity the right fossa of the abdomen may be demonstrated (Fig. 2), and by moving it to the right side the left fossa is brought into view (Fig. 3). In spite of the various curves, folds, and twists, which affect the shape of the intestine and its mesentery when, under normal conditions, they lie within the abdominal cavity, the mesenteric partition between the two abdominal fossæ must still to a certain extent continue to exist and to some slight degree must separate the two sides of the abdominal cavity, a circumstance which certainly should be borne in mind in case any attempt is made to cleanse the peritoneal cavity by flushing. It is, I think, a point worth noting that in case we have to wash out the abdominal cavity, the mesentery on the two sides of any loop of small intestine will conduct the tip of the irrigating tube to the bottom of the two fossæ. We can thus at once flush out the great right and left cavities from the bottom in a manner which must certainly be an improvement over the old custom of pushing the irrigating tube aimlessly into different parts of the abdominal cavity.

The correspondence between the different parts of the small intestine and the deep attachment of the mesentery is made evident here (Figs. 1, 2, and 3); and it becomes more obvious why the upper part of the intestine would be most apt to occupy the upper part of the abdomen and the lower part of the intestine the lower part.

A demonstration somewhat similar to the above may be made in the following manner: the intestine is gathered upon a large fork-shaped instrument, between the prongs of which the mesentery is drawn. This method of demonstration has the advantage of not requiring an opening into the lumen of the gut (Fig. 4).

Or, still again, a very effective way of displaying the whole intestine and its mesentery at the same time is to suspend the intestine as before, except that it is held in place by means of stout copper wire, which has been introduced into the gut, and is then bent in such manner (first to one side, and then to the other) that it throws the gut itself into a long series of alternating loops. When thus arranged the intestine is exposed for its entire length, and the mesentery with its ruffled border is spread out so that the whole extent of its two surfaces can at once be inspected with ease (Fig. 5).

[1]Figures 1, 2, 3, 5, 6, 7, and 12 were copyrighted by J. B. Lippincott Co., 1903, 1905, 1908, respectively.

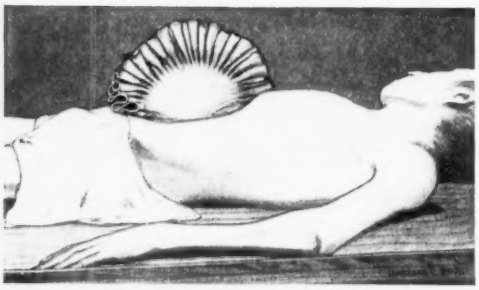

Fig. 5. The intestinal tube has been thrown into alternate curves which are held in place by means of a stout copper wire within the gut. The alternating arrangement of the loops is most evident near the lower end of the ileum. The mesentery is flat up to the place where the ruffled edge begins. (Drawn, with slight modifications, from a photograph.)

The mesentery. As it is naturally desirable that one should be familiar with the characteristics of the mesentery, it is perhaps well to review certain facts about it. The translucency of the mesentery varies enormously and is largely dependent on the absence of fat; the less fat the greater the translucency, the more fat the less the translucency. As a rule, there is less fat in those parts of the mesentery opposite the upper portions of the intestine than there is in those parts opposite the lower portion of the intestine, where the mesentery may be wholly opaque.

That part of the mesentery where the vessels enter is, as pointed out by Treves, the real root of the mesentery; but as the mesentery itself is attached to the back part of the abdominal cavity for about 6 inches below that point, the root of the mesentery is usually considered to include this 6 inches of attachment. This root lies obliquely in reference to the spine, and it can be roughly marked out on the abdominal wall (Fig. 6).

Though the root of the mesentery measures only about 6 inches, the intestinal border of this structure may measure from thirty to fifty times as much or even more. This, of course, means an enormous expansion; one which, however, is greatest in the outer third or fourth of the mesentery. It is this greatly elongated outer, or "ruffled," border that the surgeon has to deal with most often.

It is obvious that such a structure as the mesentery, in order that it may be accommodated in the abdominal cavity, must be thrown into many folds, folds which are even more numerous in cases in which the length of the intestine, which averages about 21 feet, is greater than usual. These folds are naturally simplest near the root of the mesentery, where the diameter of that structure from above downward is comparatively little increased. Of these main folds, the first one, arising from the upper part of the mesenteric root, is usually directed to the left side of the abdomen; the next one to the right; while those arising below proceed somewhat indefinitely from the lower part of the mesenteric attachment to both sides of the abdomen and the pelvis.

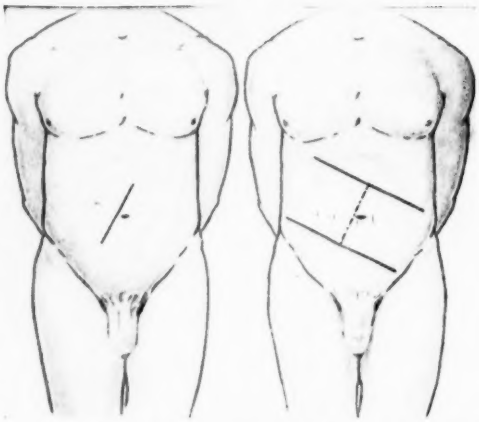

Fig. 6, left. Showing approximately the line of the mesenteric root as traced on the abdominal wall.

Fig. 7. Two oblique lines (black) have been drawn at right angles to the two ends of the line (dotted) of the mesenteric root. The upper, middle, and lower compartments, here indicated, contain in most instances the upper, middle, and lower thirds of the small intestine respectively.

MEANS AVAILABLE FOR LOCALIZING A LOOP OF INTESTINE AS TO POSITION

In order properly to localize a loop of intestine which presents itself in an abdominal wound, one should be familiar with the following: (1) the part of the intestine most likely to be encountered in wounds in the different parts of the abdominal wall; (2) the general characteristics of the intestine in the different parts of its course, together with the characteristics of the attached portions of the mesentery.

The part of the intestine most likely to be encountered through wounds in different parts of the abdominal wall. In a general way it may be said that the uppermost third of the intestine usually occupies the large cavity on the left side of the abdomen, high up underneath the ribs; the middle third occupies the middle part of the abdomen and the left iliac fossa; and the lowest third helps to fill the pelvis and the right iliac fossa.[1]

[1]This disposition of the various parts of the intestinal tube agrees, in general, with that spoken of by Mall as the "normal" arrangement.

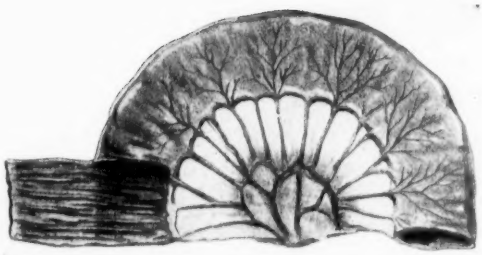

Fig. 8. A loop, with attached mesentery, from the small intestine of a thin muscular (male) subject. It belongs to the uppermost part of the bowel, as is shown by its large size, its obvious thickness, its vascularity, and by the presence of large and numerous valvulæ conniventes (a segment of the intestine being opened up to display them); and also because of the presence of large, long, and straight vessels in the mesentery, radiating to the gut, from arches mostly primary. There is very little fat in the mesentery, and the transparent spaces between the vessels are very extensive.

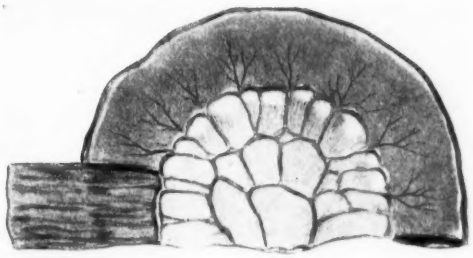

Fig. 9. A second loop, with attached mesentery, from the same intestine as that from which the loop shown in Figure 8 was taken. It belongs, however, to the lowest part of the bowel, as is shown by its smaller caliber, its comparative thinness, the absence of vascularity and of valvulæ conniventes; and also by the presence in the mesentery of comparatively short, small, and somewhat tortuous vessels which radiate from arches mostly secondary or tertiary. The fat in the mesentery is more abundant than in the specimen shown in Figure 8, and it approaches nearer to the intestine. For this reason the mesentery here is much more opaque, the vessels are somewhat obscured, and the transparent areas small.

Occasionally a loop from the lowest part of the intestine may be found high up in the abdomen, but this is unusual; and it is perhaps even more unusual for a loop from the highest part of the intestine to lie near the pubes.

The 3 compartments which the different thirds of the intestine (from above downward) usually occupy can roughly be outlined on the surface of the abdomen by means of two lines, which are drawn at the two extremities of the oblique dotted line (representing the mesenteric root) and at right angles to it (Fig. 7). The surgeon may, therefore, knowing what compartment his incision has opened up, roughly determine what part of the intestine he is most likely to encounter.

The general characteristics of the intestine in the different parts of its course, together with those of the attached portions of the mesentery. If one examines the entire length of the bowel (and its attached mesentery) one finds that many of the characteristics of the loops belonging near its upper end vary considerably from those of the loops near its lower end; but one also notices that these changes take place in the course of the tube not abruptly, but gradually; and, further, that this gradual change applies equally to the characteristics of the attached mesentery. The contrast between the characteristics of the upper part of the intestine and its lower part are generally more marked in the male than in the female.

If the surgeon examines a loop of small intestine which belongs in the uppermost part of the bowel (Fig. 8), he will probably notice that it is of large caliber and thick or even "fleshy." If he holds it now between the thumb and fingers of one hand, and, stroking it gently downward in the direction of its axis between the thumb and fingers of the other, he will distinctly feel the valvulæ conniventes as his fingers pass over them. He will probably notice also that the intestine is very vascular, being covered with numerous branching vessels. Indeed, everything about the loop will probably suggest to him a high degree of physiological activity of this part of the bowel.

The amount of information which the surgeon will get by an examination of the attached mesentery depends largely on the amount of fat there. If, as one would expect in a thin subject, there is little fat in the mesentery, he will be able to see the blood vessels,[1] to note their characteristics, and thus to get considerable information as to the part of the mesentery he is examining; but, if there is so much fat as to conceal the vessels entirely, he will, for localization purposes at least, not secure very much information. Luckily, however, the fat opposite the upper part of the bowel is not often present to such a degree as entirely to conceal the vessels, and they—at least that part of them nearest to the intestine—are usually fairly well defined. In a case then, in which the vessels are visible, the surgeon will

[1] Diagrammatically speaking, the main branches of the superior mesenteric artery unite with each other by means of a series of arches, the convexities of which face the intestine. Those arches opposite the upper end of the bowel are mostly primary, but upon these, as one proceeds down the mesentery parallel with the intestinal tube, secondary and then tertiary arches are seen to be superimposed upon the primary ones. From these arches little vessels—the vasa recta-run to the intestine, upon which they ramify, alternating, as a rule, from one side of it to the other. The arrangement of the mesenteric veins is somewhat similar to that of the arteries.

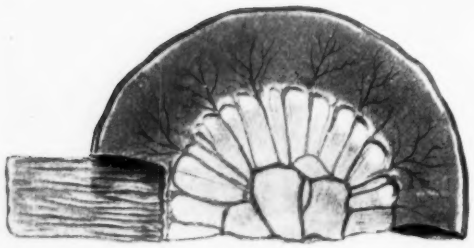

Fig. 10. A loop, with attached mesentery, from the small intestine of a female subject, which had less muscle and more fat than the subject which furnished the specimen in Figures 8 and 9. This loop belongs to the uppermost part of the bowel, as is shown by its large size, its comparative thickness, its vascularity, and the presence of large and numerous valvulæ conniventes; also, by the large, long, and straight vessels in the mesentery, which vessels radiate to the gut from arches mostly primary. There is a good deal of fat in the mesentery, and, because of this, the vessels are somewhat obscured, and the transparent areas near the intestine are very small.

Fig. 11. A loop, with attached mesentery, from the small intestine of the same subject as the loop in Figure 10. It belongs to the lowest part of the bowel, as is shown by its thinness, its small caliber, the absence of vascularity and of the valvulæ conniventes; also by the fact that the vessels in the mesentery are hidden in a thick layer of fat. Little tabs of fat encroach upon the wall of the intestine itself.

probably notice at once that these vessels are large, long, and straight and that they radiate from the depths of the mesentery directly to the intestine. He will probably also be able to see, especially if he retracts the edge of the wound, that these vessels arise mostly from the primary arches, deep in the mesentery. A few secondary arches may be seen, but these are usually more characteristic of the mesentery opposite lower parts of the intestine. The parts of the mesentery between the vessels will probably be more or less translucent, or, when near the intestine, even transparent. These transparent spaces between the vessels appear like little windows, as it were, through which one may look; because of their shape and transparency I have called them "lunettes."

Fig. 12. A method of determining the real direction of the intestine by palpation of the mesentery.

In a loop of bowel from the lowest third of the intestine the surgeon sees a different picture (Fig. 9). This loop of bowel is usually, though not always, thin and has generally a somewhat smaller caliber than a loop from the uppermost part of the bowel. Few valvulæ conniventes can be felt through its walls, or even none at all. Finally, it is probably less vascular than is the loop higher up in the bowel.

The vessels of the mesentery, if they can be seen at all through the fat, are noticed to be comparatively short, small, and often more or less tortuous in their course. If the edge of the abdominal wound is strongly retracted these may be seen to arise from secondary, or even tertiary, arches. Everything, in fact, will probably suggest to him a low degree of physiological activity which possibly explains why such great lengths of this part of the intestine may be excised without seriously interfering with the nutrition of the patient. Excision of only a few feet of the upper part of the jejunum would probably result in death.

There is almost always more fat in this part of the mesentery than there is in that part of it attached to the upper portions of the bowel.[1] For this reason the mesentery here is much more opaque. Moreover, the fat usually reaches nearer to the intestine, a common characteristic of this part of the mesentery being that little tabs of fat project from it upon the bowel itself (Fig. 11), a condition rarely found in the mesentery opposite the upper part of the intestine, except in subjects with an unusual amount of fat.

[1] The increased thickness of the lower part of the mesentery is not only due to the deposition of fat, but also to the presence of fibrous and muscular tissue which is said to aid in the support of the lower coils of the intestine.

Figures 10 and 11 show two loops of intestine from a somewhat adipose female subject. The first loop is from the uppermost third of the intestine and the second one from the lowest third. The excess of fat in the first specimen somewhat obscures the mesenteric vessels and in the second specimen practically hides them.

It is for the surgeon, then, when he examines a loop of bowel and its mesentery, to determine its approximate position by roughly estimating in his mind the stage of the transition (in the characteristics referred to) which the loop of bowel and its attached mesentery suggests, this estimate being strengthened, or modified, by the knowledge as to the part of the abdominal cavity in which the loop has been found.

The thicker, the larger, the more vascular the loop of bowel, the more distinctly the valvulæ conniventes can be felt through its walls; and, in the mesentery,—in case the amount of fat does not conceal them,—the larger, the longer, the straighter the blood vessels, arising, as they do, from "primary arches;" and the greater the transparency of the mesentery (or, at least, its translucency), the more probable it is that the loop in question belongs to the upper part of the bowel.

On the other hand, the thinner, the smaller, the less vascular the loop, the less distinctly the valvulæ conniventes can be felt through its walls; and, in the mesentery,—in case the amount of fat does not conceal them—the smaller, the shorter, the more tortuous the mesenteric vessels, the more they appear to rise from secondary, or even tertiary arches; the thicker and more opaque the mesentery itself,—especially if tabs of fat project from it upon the bowel,—the more likely it is that the loop belongs to the lower part of the bowel.

It is not by any one of these signs, but by a combination of them, including, of course, proper consideration as to the part of the abdomen in which the loop lies—that the surgeon makes his estimate as to the part of the bowel to which the loop belongs. His localization may not be very exact; but, when he needs the information, the localization, as he has made it, is probably better for his purpose than no localization at all.

MEANS AVAILABLE FOR DETERMINING THE DIRECTION OF A LOOP OF INTESTINE

To know the real direction of the bowel in any given loop is, of course, often useful to the surgeon. This can be easily determined by reference to that part of the mesentery which lies between the intestinal loop and the mesenteric root. One procedure is as follows: the loop in question is drawn well out of the wound and its two extremities held upward by an assistant, the axis of the loop being kept parallel to the known axis of the mesenteric root (Fig. 6). The surgeon's right hand is now applied to the loop in such manner that his thumb is on one side of the mesentery and his first two fingers are on the other (Fig. 12).

The thumb and fingers are then gently pushed down toward the root of the mesentery. If, by palpation of the mesentery, the surgeon succeeds in determining that there is no twist in it, he at once knows that the upper end of the loop (as it is then held) will, if followed up, conduct him to the duodenum and the lower end to the ileocæcal valve. If, however, there is a twist in the mesentery, the surgeon should withdraw his hand, remove the twist by turning the loop of bowel, and examine again. When, finally, no twist remains in the mesentery, and the loop of bowel is parallel with the known direction of the mesenteric root, the surgeon knows that the upper end of the loop is nearest to the duodenum, and the lower end to the ileocæcal valve.[1]

The same determination as to direction may be made by palpation of only one side of the mesentery, or even by inspection alone, if the abdominal wall on one side of the wound, and the coils of intestine under it, are strongly retracted.

So much for the localization of a loop of small intestine as to position, and also as to direction. It has certainly been of much use in the past. But,—if for no other reason than that the more a surgeon knows the better, concerning the region in which he is operating,—a careful consideration of its technique must be worth while.

[1] It was not until long after I had made these tests that I realized that this method for determining direction, by reference to the mesentery, had been spoken of before. The earliest allusion to it, which I found, was in an article by Dr. R. F. Rand (Lancet, Dec. 22, 1883, p. 1083).

X-RAY STUDIES ON THE MECHANISM OF LABOR WITH SPECIAL REFERENCE TO PUERPERAL INFECTION

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THE purpose of this paper is to report clinical X-ray studies concerning the mechanism of labor with reference to puerperal infection. In previous publications puerperal infection has been ascribed to the mechanism of labor as an etiologic factor. Mayes has stated: "the advance and regression of the presenting part act similarly to the plunger of a syringe and draw the secretions laden with micro-organisms to the region of the torn and bleeding cervix." Numerous other observers have remarked on the progression and regression of the birth product during labor —especially during the second stage—and have suggested the possible retraction of the cervix. On the other hand, certain authors, notably Schickele, question the retraction of the lower uterine segment and believe that the cervix dilates only and has no power to contract. Schickele reports as anomalous the cervical contraction which we believe is normal according to this present study.

Some support has been given to the likelihood of the excursion of the presenting part within the uterus by bacterial studies made before, during, and after labor, and the results are especially impressive when compared to the febrile reactions following labor. These studies, reported by numerous investigators,[1] indicate that 35 per cent of all women have pathogenic bacteria in the vagina; 20 per cent have streptococci; and 4 to 5 per cent have hæmolytic streptococci. Of those women with pyogenic bacteria present 4 per cent have fever, while 18 per cent of those with streptococci and 75 per cent of those with hæmolytic streptococci develop fever. When one totals the number of febrile reactions resulting from all labors, the average is approximately the figures given by these bacteriological studies—7 or 8 per cent—thus giving a very definite relation between vaginal flora and puerperal infection.

Additional support is furnished by bacteriological analyses made during cæsarean sections—as reported by Zangemeister, and Harris and Brown, to the effect that 6 hours after the start of labor, bacteria are found in the uterus during cæsarean section, while before the 6-hour period bacteria are not usually present. This shows that the action of labor has some bearing on the presence of bacteria in the uterus.

[1] Names indicated in bibliography by asterisk.

This present study was undertaken with a view to demonstrating the mechanism of labor and ascertaining, if possible, the bearing which such mechanism might have on the development of infection during the puerperium.

It was felt that if one could portray the relation between the cervix and the fetal head or presenting part during a contraction, and then again during the immediately following period of relaxation, any difference in the measure of distance between the cervix and the crown of the fetal head would represent the excursion of the birth product within the uterus. As such a study in animals would obviously be inconclusive, it must be made on the human subject.

A first effort was undertaken to outline the vagina and the fornices by injection of lipiodol—first applying to the vaginal mucosa an antiseptic. X-ray pictures taken under these circumstances show descent of the presenting part into the pelvis during contraction with ascent during relaxation, but reveal no outline of the vagina, fornices, or cervix, and thus give no relation between the head and the uterus; in other words they do not show the action within the uterus.

It was then recognized that some metal fragment must be attached to the cervix early in labor in order to identify the cervical margin in the X-ray. A skin clip of the Michel variety was used and this was inserted into the vaginal portion of the anterior lip of the cervix when dilatation had approximated 3 centimeters. In 6 of these patients it was impossible to secure the X-ray pictures, either because of the rapidity of labor (5 cases) or the absence of the radiologic technician (1 case). From a study of 12 patients, 6 X-ray pictures were completed; clips were used in the cervix in four of these cases and in these cases only is the relation of the presenting part to the cervix shown.

CASE 1. Mrs. E. P. A., aged 27 years; primipara; housewife with no worries. Father died of pneumonia; mother, 1 brother, and 3 sisters were living and well. Patient had been married 3½ years; her husband was well. Menstruation commenced at 13, recurring every 28 days, and lasting 3 to 4 days, with no pain and no leucorrhœa. The last period was August 25, 1927. Patient had had measles, mumps, scarlatina, pertussis, chicken pox, and influenza.

Patient had had some vomiting during the first trimester with tingling of the breasts and slight frequency. She felt life at 4½ months and after that time felt excellent and gained weight normally. Physical examination disclosed

Fig. 1.[1] Case 1. First X-ray taken during contraction. Dilatation 3½–4 fingers. Position, left occiput posterior. Clip in anterior lip of cervix.

Fig. 2. Second roentgenogram taken during the period of relaxation immediately following the contraction shown in Figure 1.

a well developed, well nourished woman of stated age with clear skin and no enlargements of lymphatics. There was no tenderness on pressure of the sinuses; the movements and reactions of the eyes were normal; ears, nose, and mouth were also normal. The thyroid gland presented a slight enlargement. The lungs were clear on inspection, palpation, percussion, and auscultation. The heart was in the usual position; the apex beat, which was regular (80 per minute) was in the midclavicular line in the fifth interspace. Blood pressure was 115–70. Percussion of the genito-urinary system elicited no tenderness. The uterus was enlarged with child in the left occipito-anterior position. Rectal and pelvic examinations early in pregnancy showed no obstruction in the birth canal. The pelvic

[1]The X-ray pictures in this article were taken at New Asbury Hospital, Minneapolis.

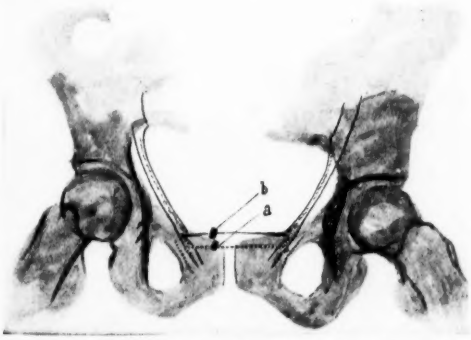


Fig. 3. Comparative drawing. In *A* the pelves of the X-ray pictures are overlapped (matched) one on the other. The clips indicate the descent of the uterus in the pelvis during contraction, dotted line *a*, with its ascent during relaxation, *b*. In *B*, the clips of the X-ray films are overlapped (matched) one on the other. The relation of the heads of the two X-ray films indicates the motion of the presenting part within the uterus. Dotted line *a* is the level attained during contraction while the blocked figure *b* indicates the ascent within the uterus during relaxation.

Fig. 4. Case 2. First X-ray picture taken during contraction. Dilatation complete. Position, middle left anterior. Clip in anterior lip of cervix.

Fig. 5. Second picture was taken during the immediately following period of relaxation.

measurements were as follows: interspinous 27, intercristal 32, intertrochanteric 35, bituberous 8, external conjugate 20, internal conjugate 13, with allowances for body thickness, 9. The patient was seen only 4 times during pregnancy, and each time her blood pressure was below 120 systolic and 70 diastolic, with urine showing no albumin, sugar, or microscopic pathology.

Labor started at 1:00 a.m., June 8, 1928. At 5:00 a.m. effacement was complete, with the head above the spines. At 6:00 a.m. an intravaginal mercurochrome preparation was given and a skin clip applied. At 9:45 a.m. there was 1.5 to 2 centimeters of dilatation. At 4:30 p.m. an X-ray picture was taken at 3.5 to 4 centimeters dilatation. The membranes ruptured at 6:35 p.m. and at 6:55 p.m. a female child was delivered with second degree tear. At 7:09 the placenta was delivered complete with single Credé expulsion and a blood loss of 150 cubic centimeters.

First comparative tracing shows descent of uterus into the pelvis ¼ inch during contraction, with ascent during the period of relaxation immediately following.

Second comparative tracing shows a left occipito-anterior cephalic presentation; first picture during contraction shows retraction of the cervix ¼ inch with its descent in relation to the head during relaxation—an excursion of the presenting part within the uterus of ¼ inch.

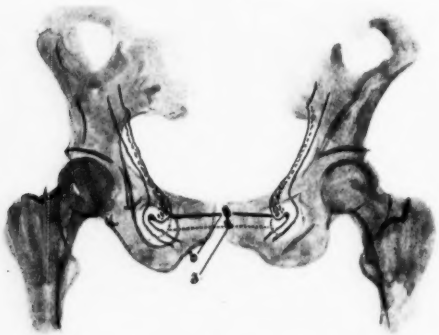


Fig. 6. Comparative drawing. In *A* the pelves are overlapped (matched) one on the other. The clips indicate the descent of the uterus in the pelvis during contraction, dotted line *a*, with its ascent during relaxation, *b*. *B*, the clips are overlapped (matched) one on the other. The relation of the heads of the two X-rays indicates the motion of the presenting part within the uterus. Dotted line, *a*, is the level attained during contraction while the blocked figure, *b*, indicates the ascent within the uterus during relaxation.

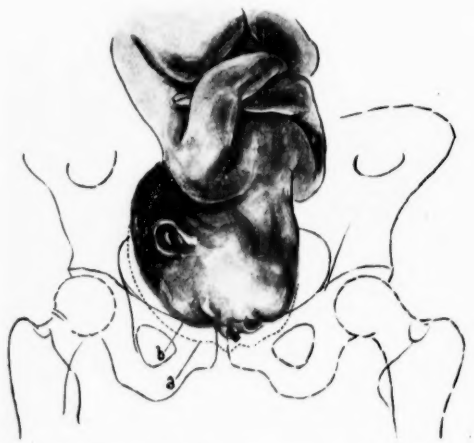


Fig. 7. Case 3. First X-ray film taken during contraction. Dilatation complete. Position, right occiput posterior. Clip in anterior lip of cervix.

Fig. 8. Second picture taken during the immediately following period of relaxation.

CASE 2. Mrs. M. C. B., aged 42 years; secundipara; housewife; enjoys life but has financial worries. Father died at 59 of bronchitis; mother, 4 brothers, and 1 sister were living and well. Patient was married in July prior to appearance; her husband was well. She had had a stillborn boy 5 years previously after difficult labor. Menstruation commenced at 14, recurred regularly every 28 days, the flow lasting 5 days with no pain, but with leucorrhœa. The last period had been October 5, 1927. Patient had had measles, scarlatina, pertussis, chicken pox, influenza, and much sore throat with neuritis. She also had occasional attacks of right maxillary sinusitis and had had appendicitis 5 or 6 years previously without appendectomy.

Patient had had quite distressing nausea and vomiting during the first trimester, with some frequency, and enlargement of the breasts. She first felt life on December 27, 1927. Physical examination disclosed a well developed, fairly well nourished woman of 42 with slightly dark pigmentation of the skin; no enlargements of the lymphatics. Motions and reactions of the eyes were normal; there was no injection of the ears; the nose was clear and free. Teeth were all gone and the tonsils were present though not injected. The neck presented no enlargements. The

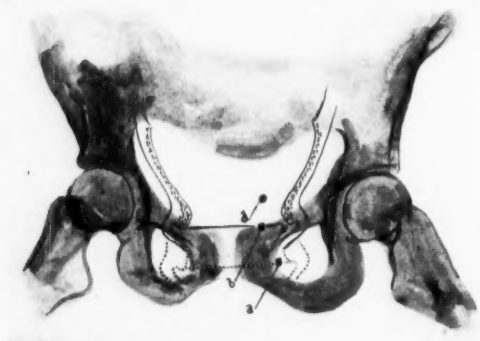
Fig. 9. Comparative drawing. In *A*, the pelves are overlapped (matched) one on the other. The clips indicate the descent of the uterus in the pelvis during contraction, dotted line *a*, with its ascent during relaxation, *b*. In *B*, the clips are overlapped (matched) one on the other. The relation of the heads of the two X-ray films indicates the motion of the presenting part within the uterus. Dotted line, *a*, is the level attained during contraction while the blocked figure, *b*, indicates the ascent within the uterus during relaxation.

Fig. 10. Case 4. First X-ray film taken during contraction. Dilatation complete. Position, left occiput anterior rotated into occiput anterior. Clip in anterior lip of cervix and also one in anterior wall of vagina.

Fig. 11. Second picture taken during the immediately following period of relaxation.

apex beat of the heart was in the fifth interspace in the midclavicular line. Blood pressure was 82-54. The lungs presented no variance from normal on inspection, palpation, percussion, or auscultation. There was some tenderness over the appendiceal region; the uterus was large with child in the occiput posterior position. Rectal and vaginal examinations showed no obstruction to the passage of the birth product; the cervix was soft. Pelvic measurements were as follows: interspinous 23, intercristal 26, intertrochanteric 32, bituberous 7.5, external conjugate 18, internal conjugate 10.5, with allowance for body thickness 8.5. This patient appeared only twice during her pregnancy and was extremely difficult to manage because of ignorance.

Labor started June 19, 1928, at 6:00 a.m. Intravaginal mercurochrome preparation with introduction of clip was done at this time. At 10:20 p.m. rupture of the membranes occurred at the approximate time of complete dilatation. X-ray study was made at this time. The patient was placed under ether and version was attempted first; then forceps rotation, with deep episiotomy. The fetal heart beat fell to 40 per minute and the delivery of the



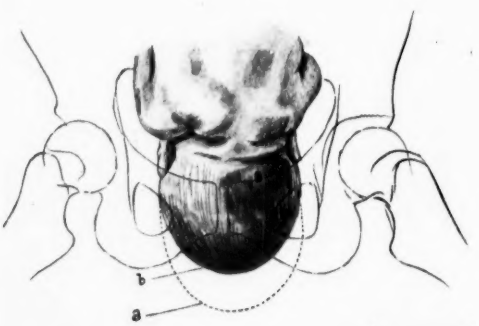


Fig. 12. Comparative drawing. In *A*, the pelves are overlapped (matched) one on the other. The clips indicate the descent of the uterus in the pelvis during contraction, dotted line *a*, with its ascent during relaxation, *b*. In *B*, the clips are overlapped (matched) one on the other. The relation of the heads indicates the motion of the presenting part within the uterus. The dotted line, *a*, is the level attained during contraction while the blocked figure, *b*, indicates the ascent which is made within the uterus during relaxation.

head was compelled with the chin under the pubis. The size of the dolichocephalus forced the passage of the occiput with the superior fetal thorax. A dead baby boy was delivered. Skin clips were removed from the cervix. The placenta was expelled complete with a loss of 500 cubic centimeters of blood. The episiotomy was carefully repaired with chromic No. 2 catgut. The patient subsequently developed cystitis with slight infection of the perineal incision. Autopsy of the child showed intracranial hæmorrhage and pulmonary atelectasis.

X-ray negatives show occiput posterior, chin anterior with marked dolichocephalus, clip attached to anterior cervical lip.

First comparative tracing shows slight descent of uterus into pelvis during contraction with ascent during relaxation.

Second comparative tracing shows expulsion of the head out of the cervix approximately ¼ inch, with its ascent during relaxation; and excursion of ¼ inch of fetus within uterus.

Case 3. Mrs. J. L. M., aged 23 years, primipara; housewife, enjoys life, no worries. Father, mother, and one brother were living and well. Menstruation commenced at 14, recurred regularly every 28 days, and lasted 4 to 5 days, with no pain or leucorrhœa. The last period had occurred March 8, 1928. Patient had been fairly well all her life. She had had measles, mumps, and sore throats, prior to tonsillectomy 2 years previously.

Patient had had no nausea or vomiting during the first trimester; there had been slight filling of the breasts, but no frequency. She felt life at 4½ months. Physical examination disclosed a well developed, well nourished woman of stated age, with no enlargements of the lymphatics. The eyes, ears, nose, and mouth were normal. The neck presented no masses or enlargement of the thyroid. The apex beat of the heart was in the fifth interspace, in the midclavicular line. The pulse was regular; the heart beats 78 per minute. Blood pressure was 118–80. The abdomen presented no masses or tendernesses. The uterus was enlarged with child. Rectal and vaginal examinations disclosed a birth passage free from obstruction and a soft cervix. Pelvic measurements were as follows: interspinous 24, intercristal 27, intertrochanteric 33, bituberous 8, external conjugate 20, internal conjugate 13, allowing for body thickness, 9.

Labor started at 3:00 a.m., December 23, 1928. Mercurochrome preparation with introduction of skin clip was done at 6:10 p.m. At 7:20 p.m. 1/100 grain of scopolamine with ⅙ grain of morphine sulphate was given. Dilatation measured 3½ centimeters at this time. At 9:15 p.m. 1/100 grain of scopolamine was given; dilatation was complete. One two-hundredth grain of scopolamine was given at 1:30 a.m. December 24, 1928. At 1:45 X-ray pictures were taken. Ether anæsthesia was administered at 2:50 a.m. At 3:05 a.m. forceps were applied with rotation (DeLee's maneuver) and a fairly deep episiotomy was performed in left posterior oblique. A female child which cried spontaneously was delivered at 3.17 a.m. The placenta was delivered complete with single Credé pressure at 3:29 a.m. At 3:30 a.m. the clip was removed and the perineum repaired.

X-ray negatives show occiput posterior position; complete dilatation; clip attached to anterior lip of cervix.

First comparative tracing shows slight descent of uterus into pelvis during contraction with ascent during relaxation.

Second comparative tracing shows expulsion of the head from the cervix approximating ⅜ inch with its ascent into the uterus during the immediately following period of relaxation.

Case 4. Mrs. K. I. M., aged 21 years; typist and homemaker, with domestic worries. Father, mother, 4 brothers, and 4 sisters were living and well. Patient had been married 6 months. Her husband was well. Menstruation commenced at 13, then 15; it was regular from then on every 28 to 30 days, lasting 8 days, with terrible pain for 1 or 2 days. Patient had had some leucorrhœa since the first period. The last flow had started March 23, 1928. Patient had had measles, mumps, scarlatina, pertussis, diphtheria, pneumonia, influenza, and sore throats up to 5 years previous. Patient had had appendectomy and treatment for varicose veins.

The patient flowed for one day on June 5, 1928, and had slight bleeding for a few minutes on June 21, 1928. She had some vomiting and frequency but very few breast changes. Bleeding occurred again, according to the patient, in the eighth month, but this hæmorrhage was not observed by the attendant or consultant. Physical examination disclosed a well developed, well nourished young woman. Her skin and mucosæ were of normal turgor, moisture, and texture. No lymphatic enlargements were present. No tenderness was elicited on palpation over the sinuses. The eyes, ears, nose, and mouth were normal. The neck presented no enlargements. The apex beat of the heart was in the fifth interspace, midclavicular line. The lungs were clear on inspection, palpation, percussion, and auscultation. No masses or tenderness were present in the abdomen. The uterus was enlarged with child, and was slightly larger than the corresponding period of gestation. Rectal and vaginal examinations showed no obstruction to the birth passages. The cervix was normally soft but firm. Pelvic measurements were as follows: interspinous 21, intercristal 27, intertrochanteric 30, bituberous 8, external conjugate 18, internal conjugate, allowing for body thickness, 9. This patient gave a history of bleeding several times during gestation. Careful examination offered no evidence of placenta prævia or other pathology. The fetal heart rate remained constant throughout the periods of inspection. The urine remained free from sugar and albumin and the blood pressure below 120–80.

Labor started at midnight, December 30, 1928. At 10:00 a.m. intravaginal mercurochrome preparation was done and a skin clip was introduced in the cervix and another one in the anterior vaginal wall. Scopolamine in the amount of 1/100 grain and morphine sulphate in the amount of ¼ grain was administered at 10:25 a.m. At 12:00 noon 1/100 grain of scopolamine was given. At 3:00 p.m. the head was above the spines, and there was 1½ centimeters of dilatation. One two-hundredth grain of scopolamine was given at 5:00 p.m. At 6:20 p.m. the head was above the spines, and there was 3 centimeters of dilatation. Scopolamine in the amount of 1/200 grain was given at 8:20 p.m. At 9:10 p.m. the membranes ruptured, and dilatation was complete. At 9:40 p.m. an X-ray study was made while the vulva bulged and separated so that the head was just visible. A baby girl was delivered spontaneously without laceration at 9:59 p.m. and the clip removed. The placenta was delivered complete at 10:36 p.m. with single Credé pressure. The loss of blood amounted to 150 cubic centimeters.

X-ray negatives show occiput anterior—rotated from occiput left anterior, with clip attached to anterior vaginal wall at the approximate level of the cervix at start of labor, while lower clip is in the anterior lip of the cervix.

First comparative tracing shows descent of uterus into pelvis of 1 inch during contraction, with its return into the pelvis during relaxation.

Second comparative tracing shows expulsion of the presenting part from the cervix a distance of 1½ inches during contraction, with its ascent into the uterus during the

period of relaxation immediately following—an excursion of the birth product within the uterus of 1½ inches.

The mechanism of labor, then, as shown by these X-ray studies, presents two relations—one between the uterus and the pelvis, the other between the birth product and the uterine interior.

From the start of labor, there is a descent of the uterus within the pelvis during contraction and an ascent during relaxation. This process continues throughout labor and the excursion of the uterus within the soft parts of the pelvis constitutes from ½ to 1 inch, except where fixation of the head occurs, when it is less; or where there is stretching of the ligaments, when it might be more.

In addition to this action of the uterus, there is an excursion of the fetal presenting part within the uterus. This starts as a very minute departure of the presenting part from the uterus (or retraction of the lower uterine segment) at the start of labor, and as dilatation becomes more marked, the excursion of the fetus within the uterus is increased. Thus at 3 centimeters' dilatation it might be ⅛ of an inch, increasing gradually to an excursion of ⅜ of an inch at complete dilatation, head at the spines; finally attaining a maximum of 1½ inches' excursion when the force of the perineum adds its back pressure to the motion of the relaxing lower uterine segment. At this stage, the combination of the movement of the uterus within the pelvis, and the movement of the fetal parts within the uterus, allows for a descent of the fetal presenting part of 2½ inches within the pelvis during contraction followed by its ascent during relaxation.

Thus, the presenting part acts as a swab, smearing bacteria from the vagina onto the interior of the uterus. The studies on cæsarean section (mentioned above) give some conception of the time required to produce this action which increases as labor progresses.

To this method of spread of infection must be added any manipulation or operative delivery undertaken at the time of parturition. But in an uncomplicated case, that is a case in which vaginal examinations have not been made, in which forceps have not been applied, in which version has not been done, in which a bag has not been inserted, in which the placenta has not been removed manually, in which episiotomy has not been done, in which no tear has been produced, in which hæmorrhage has not occurred, in which the membranes have not ruptured, and which is not complicated by placenta prævia, in a case delivered without attendants and without accidents, there may still be a fatal infection which will develop from the action of the labor itself as herein described and shown by the X-ray examination. To all other factors of infection, which have been demonstrated as responsible for puerperal sepsis, must be added that of the mechanism of labor itself.

In order to counteract this method of contamination, every case of labor must be approached as a surgical operation. These cases should all receive some antiseptic preparation intravaginally early in labor, prior to the delivery of the baby, and this intravaginal antisepsis should be non-toxic and non-irritant and applied sufficiently often to be effective in destroying the vaginal flora. The results of Mayes, De Lee, and Hirst show that the morbidity has been reduced one-half by means of these methods.

SUMMARY

The mechanism of labor has been suggested as an etiological factor in puerperal infection, and to confirm this opinion a study has been made of the relation of the uterus to the pelvis and of the presenting part to the cervix, by the introduction of a clip into the anterior lip of the cervix and the exposure of X-ray films during the period of contraction, and again during the relaxation immediately following. These films show descent of the uterus within the pelvis and of the fetal presenting parts within the uterus during contraction—with ascent of the uterus within the pelvis and ascent of the fetus within the uterus during the period of relaxation immediately following.

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*See second paragraph of article.

THE SIGNIFICANCE OF THE URETER IN SURGERY

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THE importance of the ureter in the architecture of the human machine and the part it plays in the natural behavior of this machine were little understood and less appreciated until recent years. We now find that, through the medium of minds devoted to the solution of its many important problems, the intricate physiological and pathological characteristics of this organ are well known and today the discussion of it occupies one of the great chapters in urology.

The ureter not only has to contend with its own diseases and disturbances in function, but it may be the cause of many of the lesions in the kidney requiring surgery: lesions in the ureter, because of its reflections and radiations, may produce symptoms characteristic of other intra-abdominal lesions, notably appendicitis; the ureter, because of its location, may be injured during a pelvic operation; lesions of the ureter because of its reflections and invasions may produce symptoms similar to those associated with lesions of the bladder and urethra; finally, developmental anomalies of the ureter may offer an explanation for certain malformations in the bladder which have heretofore been considered of truly vesical origin.

The essential function of this highly specialized tube is to transport without impediment urine from the kidney to the bladder. Unfortunately, embryological defects and pathological conditions frequently interfere with perfect function. Embryological defects occur most often at the site of the normal physiological narrowings as valvular remnants or sclerotic processes, or they are the result of faulty development of the wall itself. Thus we may expect the dilated, tortuous, thin-walled ureter, usually producing pronounced renal disturbance, or the massive, rather straight, thick-walled duct producing little or no effect upon the renal substance, the latter being the megalo-ureter. Unless the obstructive lesions be cared for early, disastrous consequences may result to the kidneys necessitating either their removal or palliative drainage operations. Fortunately, these obstructions occur most frequently at the vesical end of the duct and often may be corrected by simple cystoscopic surgical intervention with slitting of the orifice; in other cases open plastic surgery is necessary.

In cases in which it is doubtful that, after careful ureteral catheter drainage, renal function will be restored and infection overcome, it is unwise to incise the orifice because of the danger of producing urinary fistula through regurgitation in case nephrectomy is necessary later.

The pronounced obstructions at the vesical end of the ureter I have corrected satisfactorily by the transposition operation which I described in 1918. This consists in the excision of the intramural ureter as far as its entrance to the bladder wall and the moving of the orifice back to this location. This usually permits the surgeon to remove the sclerosis. In the several cases in which I have used this technique the results have been extremely satisfactory. Frequently this condition is bilateral. The chance of recontracture after the operation described as compared to that after ureterovesical anastomosis is minimized. The operation is much simpler and is accompanied by fewer complications. The normal attachment of the ureter is retained and in my opinion this is to be desired.

The changes in caliber are productive of the most important chapter on ureteral diseases. Other developmental defects which occasionally confront us are anomalies in number, variations in length, and faulty insertion.

A present day delusion in urology concerns ureteral redundancy in the shape of kinks and twists. Pages have been written about their responsibility for kidney disease, a manifold symptomatology such as pains, general nervous manifestations, and the like being ascribed to them, and numerous operations upon the kidney being suggested for their correction. As an individual may have a long nose so he may have a long ureter. Many redundant ureters are physiological and co-incidental in the field of symptoms. Some occur as the result of excessive renal movability and necessitate surgery for their correction. Some result from aberrant vessels. The majority result from obstruction at the lower end of the duct. One of the first variations from the normal that a ureter undergoes following ligation at its lower end is an elongation and tortuosity in the region of the renal pelvis.

In the work on experimental ligation which Dr. Fisher and I did a number of years ago, we invariably found that the kinks and tortuosities

in the upper ureter were primary features of the obstruction. Therefore one should be very careful in the selection of cases for renal fixation for the correction of such kinks, unless there be a definite kink which cannot be explained by lower obstruction and one in which there is proved to be renal pain by its reproduction through filling of the pelvis, or in which there is true evidence of beginning hydronephrosis. Otherwise renal fixation should be shunned. Aberrant vessel must always be borne in mind.

Shortening of the ureter is observed chiefly in three conditions: in tuberculosis, and in two congenital lesions, the horse-shoe and the ectopic kidney.

In the presence of indefinite masses in the abdomen, a study of the ureteral and pelvic topography will frequently establish a diagnosis. I observed an example of this not long ago in a girl who presented a tender lower abdominal mass which was believed to be an abscess of the appendix. As there was pus in the urine she was referred to our department. A ureteral catheter was passed up the right ureter a much shorter distance than usual and recovered purulent urine under tension. The case proved to be an acutely infected hydronephrosis in an ectopic kidney.

Supernumerary ureters occur in about 1 per cent of cases. Double reduplication is present in about 18 per cent of these. Felix, Braasch, Harpster, Brown, Delcher, Mertz, Wedensky, and Lewis have written extensively on this subject. Kidneys having such ureters seem susceptible to disease. It is estimated by these authorities that 27 to 40 per cent of double ureters are associated with renal disease, particularly hydronephrosis, infection, and stone. It has been my experience that the upper pelvis, the smaller one, is more susceptible to disease. The double ureter is particularly apt to be productive of renal pain in which no definite clinical cause can be determined. I have seen several patients with colic without stone, stricture, movability, or pyelographic evidences of obstructions, who have had recurrent intermittent colics and the pain was typically renal and could be reproduced. In the light of the recent knowledge on peristalsis, it is possible that the crossing of the ureters interferes with normal peristaltic progression and possibly a reversal of the current with temporary blockage is the result. Surgically the problem is oftentimes the same as that for a single ureter but frequently has the advantage of lending itself to heminephrectomy.

Whether the cause of the obstruction be congenital or acquired, the one characteristic accompaniment is stasis. Ureteral stasis is the most important cause of renal infection. Of the 2,100 cases of kidney infections which I analyzed 2 years ago, 80 per cent were associated with stasis from ureteral insufficiency. Hence the significance of thorough drainage.

One type of ureteral obstruction which has received but little recognition is the self-engendered obstruction occurring at the ureteropelvic juncture. As a result of primary renal infection, with consequent swelling of the outlet, a vicious circle is created and is responsible for the so called acute pyelitis in many instances. It is in this type that prompt evacuation through the ureteral catheter insures restoration of renal function and protects the kidney against scars and inflammatory invasions which may later lead to untoward developments.

Acquired pathological obstructions of the ureter are legion and enumeration is unnecessary. Your familiarity with this subject makes me almost hesitate to mention briefly a few of the important ones.

The surgical significance of stone was shown by the fact that 7 per cent required ureterotomy. About 93 per cent can be removed by endovesical, endo-ureteral technique. Patience, careful vigilant observation, and asepsis are necessary. Frequent radiological study and repeated functional tests must be employed. If a stone shows a tendency to descend and the urinary function remains normal; if infection is absent or slight, and renal drainage is efficient, one is usually safe in continuing manipulative measures.

The insidiousness of ureteral calculus can best be illustrated by a patient whom I saw 2 years ago with a stone the size of a large almond in the renal pelvis. A ureterogram showed a normal ureter below the stone. Renal function was undisturbed. The patient disappeared for 6 months and returned having had no symptoms suggestive of disturbance in the kidney or ureter. The stone was at the vesical end of the ureter, the kidney completely destroyed and the other kidney doubly compensated. Ureterotomy would have saved the kidney. The silent travel of this large stone along a previously determined normal ureter is a warning against waiting for symptoms and signifies the necessity of repeated observation.

The technical problems of stone removal are familiar. In the upper ureter they are simple; in the lower, either simple or extremely difficult. In the midureter the Gibson incision is all that one can desire; in the lower end of the ureter, the Judd technique has simplified the removal of stones considerably. In the female, the vaginal

approach proposed by Lower has many recommendations. Whether one should close the ureter after ureterotomy is a debatable question. As far as gross leakage is concerned, it matters but little. It appears to me, however, that definite approximation of the ureter to prevent a periureteritis in the neighborhood of the incision is advisable.

In the removal of stones from the ureter it is very important to lavage the site of implantation thoroughly in an effort to remove all sandy deposits and to give a follow up dilatation and lavage during convalescence at least by the tenth day. With this I feel positive that recurrence of stone in the ureter should be very slight; not more than 2 per cent.

Stricture of the ureter occurs as a definite cause of obstruction and at times leads to great mutilation of the kidney. A great deal has been written on the subject of stricture and I shall not relate the story of its many phases. Hunner, in his repeated discussions on this subject, has emphasized the frequency and importance of stricture, and to him belongs great credit for directing attention to ureteral investigation. One should be rather guarded in designating constrictions of the ureter seen in ureterographic study as stricture, and certainly equally guarded in the interpretation of impressions from large bulbs because after all the ureter is a highly specialized involuntary muscular organ, the chief mechanism of which is dependent upon muscular activity susceptible to influences from within and without, and physiological contractions are frequently confusing in this picture. There seems to be a decided tendency to magnify the importance of these slight constrictions and dilatations and to ascribe to them a pathological significance when they merely represent true physiological conditions. Unless there be a persistent finding in the same location, associated with definite evidences of pathological change above, such as early or late dilatations of the renal pelvis, the diagnosis of stricture cannot be accurately made.

Spasms of the ureter which appear on first examination to be typical strictures may disappear, either spontaneously or under the influence of smooth muscle relaxants, particularly atropin and papaverine. Morphine, of course, while it has been currently given to relax ureteral spasm, has been proved to have the contrary effect; it is a smooth muscle stimulant and has its effect in relieving the patient only by numbing the general sensibilities. Its association with atropine makes it effective in ureteral colic.

Neighborhood inflammatory lesions or the presence of calculus will very frequently cause constrictions and contractions of the ureter in the vicinity. I have on several occasions removed calculi from the pelvis of the kidney expecting to find stricture at the upper ureter as evidenced by ureterographic study and have found the ureter perfectly normal anatomically.

This brings up the important question of ureteral study, namely, the consideration of its muscular movements or its propelling force. In conveying the urine from the kidney to the bladder, the ureter is not only a passive conductor but an active organ. The propulsion of urine is created by means of peristaltic contractions of the ureter, but additional factors, such as intraureteral pressure due to urinary secretion from the kidney, gravity in the erect posture, contractions of the diaphragm, peristalsis of the intestine, pulsations of the arteries crossing the ureter and in the vicinity of the ureter, and active contractions of the abdominal muscles assist in its function.

In comparison to the peristaltic contractions this latter group of contributory factors possess but little influence. The ureter, like the intestine, possesses three distinct types of movement; pendular, peristaltic, and antiperistaltic.

The function of the pendular movements is unknown. That they do not propel fluids in a given direction for any distance is the only fact which is known.

The peristaltic and antiperistaltic contractions are the most important and are the ones which chiefly concern us. The existence of peristaltic contractions in the ureter have never been disproved since they were described 60 years ago. An extensive literature has accumulated concerning their origin and their mode of propagation. In summarizing the various ideas on this subject it may be definitely stated that the impulses start at the tips of the calyces, and pass downward toward the bladder. They are most active in the upper ureter, least in the middle ureter, and again quite active in the lower ureter. In other words, there is not a definite metabolic gradient.

Early investigators, Budge and Valentin, believed them to have their origin from impulses sent from the central nervous system but since innumerable observers have demonstrated beyond question that the isolated and denervated ureter possesses these contractions as well as the normal, it is obvious that the central nervous system can play no rôle in their production. Their exact nature is still not definitely understood. The theory usually accepted is the one

proposed by Engelman in 1869 that these waves are of myogenic origin. Since they occur more frequently in the part of the ureter in which ganglion cells have been found by some, it has been suggested that the ganglia may possibly be responsible—a fact not sanctioned by most observers. Some believe that the contractions are initiated by stimulation of the ureter by chemical substances in the urine, particularly urea; others that the mechanical pressure of the urine is responsible.

The preponderance of contractions in the upper and lower segments of the ureter bears a definite significance to clinical medicine. It is in these locations that strictures have been reported so frequently. It is here also that pathological changes are more frequent, that is, stones in the renal pelvis, inflammatory conditions in the true pelvis and lower abdomen such as the seminal vesicle, pelvic inflammatory diseases, and appendiceal conditions. Hence, the proximity of such irritating lesions to such receptive muscle fibers as the ureter possesses may in many instances explain the pronounced contractions which are seen in these vicinities. Thus our surgical therapy might well be directed to the correction of these pathological changes rather than to manipulative technique upon the ureter itself.

The recent work of Gruber in the Pharmacological Department of Washington University on peristalsis and antiperistalsis is extremely illuminating. By a special apparatus he has been able to show peristalsis present in the excised whole pig ureter. He has demonstrated that the wave propels fluid ahead of it within the lumen of the ureter and is, therefore, a true peristaltic contraction independent of the central nervous system. He has produced spontaneous peristalsis and antiperistalsis in excised pig ureters 108 hours after excision, which length of time would seem long for nerve cells to survive. He has furthermore proved conclusively that a definite reversed peristalsis occurs spontaneously and may be created by means of thermal, electrical, chemical, and pharmacological influences. Such an observation lends itself admirably to the explanation of the rapid back-fire of stones from the ureter to the kidney pelvis, as has been observed by so many surgeons. This type of ureteral contraction, furthermore, could aid in the transportation of infection from the lower ureter to the kidney.

Peristalsis and antiperistalsis may occur simultaneously in the same ureter. It is, therefore, not unreasonable to assume that some of the peculiar filling defects and spindle dilatations may be the result of this antagonism.

The exact mechanics of the protective device at the ureterovesical orifice has been shrouded with confusion until recently. Our conception has been that the obliquity of the ureter through the bladder wall served to protect the vesical contents against regurgitation up the ureter.

In 1903 Sampson was the first to describe a valve mechanism. Other observers have spoken of sphincter in one sentence and valve in the next, but no definite information has been available until recently when Gruber beautifully demonstrated the presence of a definite ureterovesical valve in humans, dogs, rabbits, monkeys, baboons, cats, and pigs. The valve is a single flap affair, composed chiefly of connective and elastic tissues, a few smooth muscle fibers, and mucous membrane from the ureteral and vesical side. It varies in length in different animals. Gruber and other observers have shown that there is no definite sphincter in this region. The valve is the potent factor in the security of the orifice. Incision of this valve without disturbance of the intramural ureter is sufficient to allow prompt regurgitation of contents of the bladder into the ureter, and the pressure within the ureter immediately assumes intravesical pressure, whereas the normal ureter remains uninfluenced. The experiments of Gruber coincide with clinical observation and are at variance with the results of Graves and Davidoff. This may be explained by the fact that in their experiments the animals were either anæsthetized or narcotized, and the bladders were filled beyond normal distention. Hence the valves were rendered incompetent through narcosis and overstretching.

The importance of this valve cannot be overestimated and its protective influence is remarkable, yet its delicacy explains the frequent occurrence of its incompetency in the face of invasion with inflammation, neoplasm, or pronounced protracted distention. This explains the occurrence of the chill and fever accompanying the closure of a suprapubic wound. It would seem to be the result of regurgitation of the infectious material into the renal pelvis from increased vesical pressure.

Incompetency of the valve offers a very fitting explanation for ascending renal infection and offers us recompense as surgeons for bladder drainage to correct renal infections resulting from vesical neck obstruction. It explains the mortality in many cases of carcinoma of the bladder from pyelonephritis and the infection of one kidney from a tuberculous lesion of the

bladder as a result of infection in its mate. Indeed, regurgitation of the contents of the bladder into the ureter is far more common in such lesions than it is in pure simple obstructions.

In 8 per cent of 1036 cystograms examined by Bumpus there was regurgitation. In 300 cases which I observed it was present in 6 per cent.

The importance of this valve should make us extremely cautious in making free incision to remove calculi and to correct slight contractions at the orifice.

The fact that the characteristics of ureteral disease are similar to those of abdominal disease is thoroughly appreciated by surgeons. This similarity is the result of the reflections of the ureter in the regions of the appendix, in the pelvis, and even in the upper abdomen.

Before the days of real scientific accuracy in differential diagnosis, the hidden, unsuspected ureter caused at least 27 per cent of the pains which were ascribed to the appendix and for which appendectomy was performed. The gall bladder was the recipient of a few such insults as were also the stomach, intestines, and pelvic organs. Today investigation has helped to relieve this situation, and in the presence of any vague abdominal pain the ureter should not be overlooked as a possible causative factor.

As I once remarked, the surgeon should step less lightly on the smooth pavement lining of the peritoneal highway and confine many of his meanderings to the stony gutters in the rear.

The implication in pelvic surgery is an embarrassing but not an uncommon occurrence. The most frequent causes of injury are ligation, incision, and circulatory interference with pressure necrosis from clamps. Ureteral ligation predominates. It has been estimated by various observers that from 1 to 3 per cent of operations on the female pelvic organs are complicated by this unpleasant feature. This applies particularly to vaginal hysterectomy.

Fortunately, for the surgeon, the condition is unilateral in the majority of instances. It is equally unfortunate for the individual since renal sacrifice is the rule whereas in bilateral ligations, which occur in about one-third of the instances, corrective measures must be instituted to save life and renal substance.

In the experimental work which Dr. Fisher and I did in 1915 it was shown definitely that immediate nephrostomy would preserve kidney integrity and insure the thorough restoration of the lumen of the ureter. In my clinical experience and in this experimental study it was found that the ligature never absorbed before 3 weeks and that the lumen of the ureter opened in from 6 to 8 weeks and the fistula closed usually within 10 weeks. In other words, one can never hope for the absorption of catgut before the death of the kidney. The relief of back pressure upon the kidney preserves the organ until the ureter eventually assumes its patency. Our experience is that this procedure is far better than deligation, which entails an extensive operation through a raw surface on a sick patient and subjects the ureter, because of its tension and the imbedding of the ligature, to the further possibility of fistula. Time will not permit a discussion of the other ureteral injuries except to mention that certain ureteral fistulæ may heal with dilatation from below, others may require ureteroureteral or ureterovesical anastomosis while in many nephrectomy is necessary. Uretero-ureteral anastomosis, while effective in the freshly injured ureter where shortening and fibrosis has not implicated it, is far from successful in many of these lower pelvic injuries. The plastic anastomoses of the ureter by the accepted methods will give excellent results, particularly in the upper accessible ureter. Some surgeons, notably Quincy, in case of aberrant vessel cut the ureter and anastomose it rather than ligate the vessel which is obstructing it.

In discussing ureteral plastics I should cite one instance which speaks for the remarkable reconstructive, regenerative power of the ureter. In a resection of a very large, densely adherent diverticulum of the bladder, the lower end of the ureter surmounting the sac which was considerably thinned and invaded was torn during the process of resection. An attempt to anastomose it to the bladder at the end of the operation was made and the ureter was found to be so shortened as to make such a procedure impossible. I inserted a large, soft rubber catheter in the somewhat dilated ureter, placed it into a rent in the bladder, secured the catheter within the ureter by catgut ligature, and then by traction sutures between the lower end of the ureter and the bladder fixed the catheter and ureter in position. The ureter was at least 1½ inches from the bladder which I had mobilized in an attempt to do the transplantation. The wound was closed with drainage. Within 3 weeks the catheter was removed from the bladder, and the urine passed normally from the kidney into the bladder. Later the ureter was catheterized and cystogram showed normal connections. Thus the ureter, like the urethra, possesses an uncanny regenerative ability if properly bolstered. The rubber in all probability stimulated cellular activity.

Uretero-intestinal anastomosis and ureterocutaneous implantation offer no novel features and limited space prevents further comment.

The importance of defective development of the ureter in the production of congenital lesions frequently seen in the bladder is the feature of this discussion which I wish particularly to present. It has been my impression for many years that the true diverticulum of the bladder is congenital. Its opening seems to present a definite, well defined, sphincter-like margin; its walls are usually thick, and the location is usually in the neighborhood of either ureteral orifice or in the region of the urachus. Furthermore, I have never been able to reconcile myself to the belief that a small blister of mucous membrane of the bladder could dissect its way through its walls and develop into a sac of any considerable size. Also, if the diverticulum were caused by dissection it would seem that the orifice should assume various shapes and most likely present an angular or slit-like arrangement rather than a circular one.

My impression has been that maldevelopment of the ureter might explain this condition. A recent observation in an infant girl seems to offer proof to this credence. In catheterizing the right ureter for a very acute resistant pyelonephritis complicating empyema I casually observed a double orifice on the left side. Her illness prevented investigation at this time but the ureteral catheter drainage produced a prompt recovery from symptoms and in a short time another cystoscopy gave the following information: the double orifice on the left at first revealed nothing unusual; then suddenly the outer, somewhat crescentic orifice, opened and assumed the typical appearance of a diverticulum. Shortly afterward the inner orifice was seen to enter this opening through a process of contraction. A little later the two retracted and the orifices assumed their original positions. This was observed repeatedly. A catheter could pass in the outer orifice for 2 centimeters. This performance was spontaneous and not dependent upon different degrees of vesical filling.

A misdirected ureteral bud which was designed for a double ureter was responsible for this condition and in all probability such an affair is the source of many diverticula of the bladder. The longer the ureteral stump, the larger the diverticulum. With respect to the formation of the sac, it has been shown that if the valve is defective, the normal contractions of the bladder during the acts of urination over a period of time are sufficient to dilate the ureter and in such an instance to produce the sac. Obstruction is not essnetial. If nature has been so inefficient as to produce a defective ureter, we may expect it to be equally so in perfecting its valvular mechanism.

The tuberculous ureter is replete with surgical problems, different surgeons employing different methods—complete or partial ureterectomy; drainage and closure without drainage; medication and non-medication. Some apply different techniques to different types of ureteral involvement, all with about the same end-result. My personal experience in more than 100 cases of nephrectomy for renal tuberculosis has convinced me that the ureter needs no extravagant surgery but should, in the majority of instances, be ligated at a suitable distance from the kidney, preferably with cautery, and allowed to drop back into its position, without drainage. I have never had a persistent fistula from a diseased ureteral stump. The majority of such fistulæ are kept open by the tuberculous process in the region of the renal pedicle from the perirenal fat involvement. I have observed but one instance of late trouble from a tuberculous ureter; this occurred 2 years after nephrectomy for an early tuberculosis in which there was little involvement of the ureter. The patient presented pain in the lower right quadrant and slight fever. The pinpoint ureteral orifice was dilated and inspissated pus was evacuated. Prompt relief resulted with no recurrence for 6 years.

The ureter occupies a most prominent place in surgery of the kidney. It is the means of simplifying proper exposure of the pedicle in nephrectomy—if the ureter is freed and used as a tractor, that is, lifted up while it carries the kidney with it, easy access to the pedicle of the kidney is insured and the danger of hæmorrhage and injury to surrounding structures is minimized.

In fixation of the kidney it is extremely important that the ureter be freed and the kidney placed in a position in which the ureter presents an accurate alignment. In all stone operations, whether pyelotomy or nephrotomy, the patency of the ureter is of paramount importance.

The shunning of the ureteropelvic juncture in pyelotomy needs no comment and the protection of the posterior pelvic vessels is thoroughly appreciated.

But a few of the problems of ureteral surgery are presented. As time goes on, the innumerable investigators stimulated by important recent discoveries will solve many of the unexplained phenomena still existing.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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AUGUST, 1929

SUSCEPTIBILITY TO CANCER

THE incidence of cancer in various countries which compile reliable statistics is about the same, not only as to population ratio, but also as to sex, although the organs or tissues which are most susceptible to the disease vary considerably. Whereas 30 per cent of cancers in the female involve the breast and the uterus, in the male about 30 per cent involve the stomach and the organs of the urinary system.

The testis is the primitive reproductive organ, and the ovary is descended from the testis. It is possible that the longer heredity of the testis has given it great resistance to various forms of insult to which the ovary has relatively less resistance.

Cancer never develops in sound tissues. Chronic irritation, by opening up an atrium for possible entrance of micro-organisms to the body from the outside, seems to suggest an external agent. This does not explain why in certain cases in which the sources of chronic irritation are very slight, cancer develops, while in others in which the sources of chronic irritation are very extensive for great lengths of time, cancer does not develop. It is difficult to surmount the fact that when cancer has extended by metastasis to a new situation, it produces the histopathological picture of the tissues in which it originated rather than that of the organ which became affected secondarily. If the disease were due to a foreign invader, it presumably would reproduce the type of cells of the newly invaded tissue rather than that of the primary seat of the tumor.

In any event, the agents which act on the cell to produce malignancy become an integral part of the cell itself, as metastasis in the human species takes place only by transplantation of the cell.

One factor of supreme importance which has not been sufficiently stressed is that individuals vary in their susceptibility to the cause or causes of cancer, whatever they may be. In no other way can we explain why 90 per cent of persons do not have cancer and 10 per cent die from it. It is as logical to accept the hypothesis that 90 per cent of persons have greater resistance to cancer than the 10 per cent, as to attempt to force an explanation that only 10 per cent come in contact with hypothetic causative agents which produce cancer.

If the patient's susceptibility to the disease is the important factor in the development of cancer, the situation of the growth must be determined by the organ or tissue subjected to the insult of the precancerous lesion, and the grade of malignancy and the metastatic possibilities by the susceptibility of the body as a whole.

The stroma of the cancer cell is the measure of nature's resistance. The greater the amount of stroma and the less the proportion of cells, the slower the growth. On the contrary, the greater the proportion of cells and the less their resemblance to the normal tissue involved, the more rapid the growth. All there is to cancer is contained within the malignant cell which has a remarkable resemblance to the rapidly growing embryonic cells of the chorionic villi (Langhans' cells). Langhans' cells have extremely large nuclei and undergo the most rapid division of any normal cells in the body, but the nucleolus and the cytoplasm of the cell have no peculiarity of structure.

Wilson, MacCarty, and Broders have enlightened us greatly with regard to the histological character of the cell in relation to malignancy, upon which Broders' classification of the malignancy of tumors has been based. In brief, it has been found that when malignant cells are compared with the rapidly growing normal cells, the nucleolus as well as the nucleus is found to be greatly enlarged. It would appear that the size of the nucleus controls oxidation in the cell in relation to its increased blood supply, whereas the nucleolus controls the function. The increase in the size of the nucleolus, as well as the nucleus, means rapid and uncontrolled production of cells without function, which is characteristic of cancer. In other words, the greater the variation of the malignant cell over the normal, the more malignant the growth.

The studies of Murray on tar painting, those of Gye and Barnard on the transplantation of the Rous fowl toxin, the work of Slye on cancer in mice, and of Bowing and Desjardins on the effect of radium and X-ray in lessening the malignant character of the growth, all point to local and general susceptibility as being perhaps the controlling factor in the genesis of malignancy, and indicate that the possibilities of increasing resistance to cancer in the more susceptible individuals is not only a possibility but a goal which every effort must be made to reach.

W. J. Mayo.

THE ACUTE CRISES OF HYPERTHYROIDISM

THE acute crisis which occasionally appears in a patient with hyperthyroidism is at least in large measure controllable, if proper measures to combat the condition are undertaken early enough. Even if the condition has progressed to the later stages of the state, when the patient is vomiting, delirious, and uncontrollably agitated, proper measures will, in a considerable number of cases, overcome the acute crisis and permit the patient to be gotten into such a state of improvement that subtotal thyroidectomy can be done.

On the other hand, it is true that a very definite number of patients, who have been permitted to progress into the later stages of thyroid crises will go progressively on into deeper stages of the state, with uncontrollable vomiting, diarrhœa, delirium, and restlessness and die in spite of all measures which we now have at our command, including iodine.

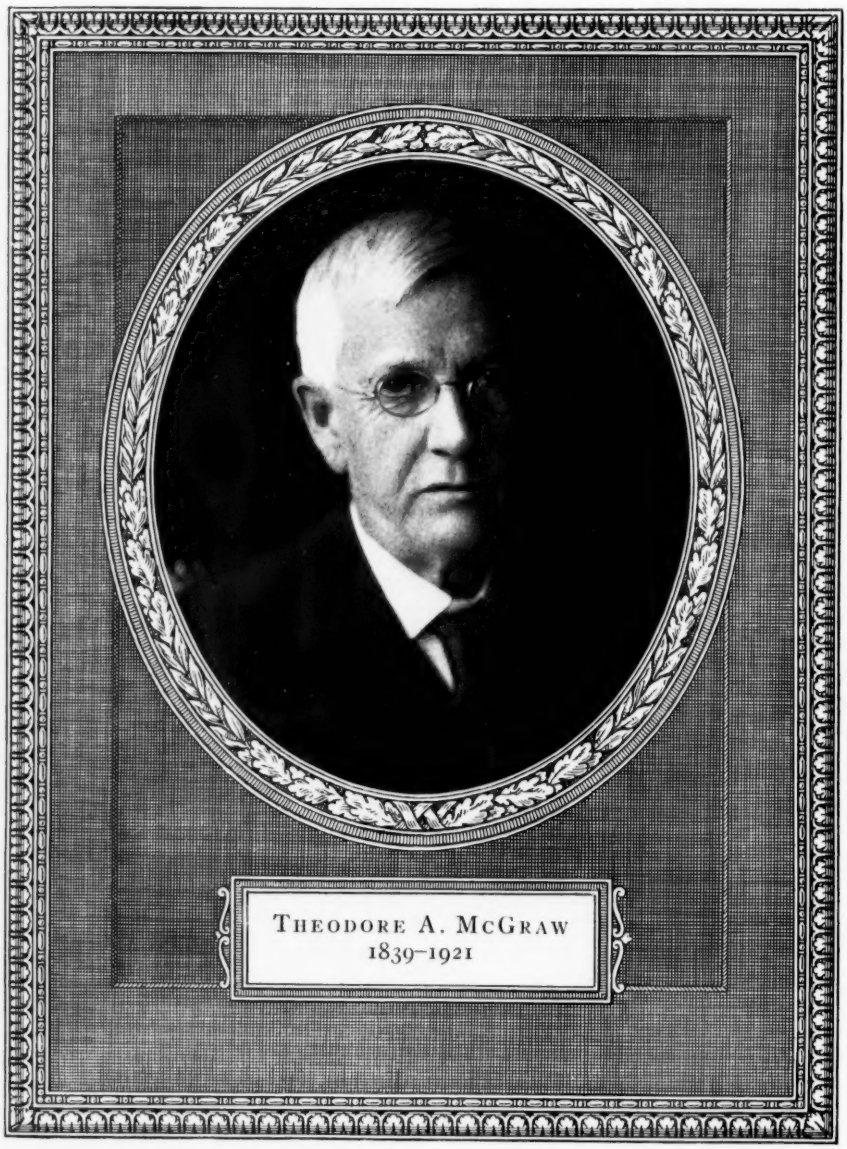
Since we know from our practical experience that this is so, it is urged that any indication of an approach to the condition of a thyroid crisis, such as marked increase in activation, sudden intensification of the signs of thyroidism, diarrhœa, and particularly vomiting, with changes in the mental state, be considered an emergency, just as an impending diabetic coma is, and urgent measures to combat it be immediately instituted.

The salvation of patients with an impending thyroid crisis are glucose, iodine, fluids, and morphine: fifty grains of glucose in five hun-

dred cubic centimeters of saline twice in twenty-four hours, Lugol's solution, by mouth, by rectum, by stomach tube, or in the salt solution, and morphia up to the point at which restlessness is controlled or the therapeutic danger point is indicated by the respirations.

It is urged that these measures be not reserved as a treatment of thyroid crisis, but that the mortality of this condition can be definitely diminished if they be employed as emergency measures against the impending occurrence of such a state.

FRANK H. LAHEY.



THEODORE A. MCGRAW
1839–1921

UNIV OF MICH

MASTER SURGEONS OF AMERICA

THEODORE A. McGRAW

THEODORE ANDREWS McGRAW was born in Detroit in 1839, the son of Alexander C. and Susanna Walker McGraw. His early education was received in the private school of Mr. Bacon and the public schools of Detroit until 1858 when he entered the University of Michigan. There were, at that time, no high schools and the universities and colleges were, in his words, "indifferent high schools masquerading under more inspiring names." He found in the University a feature then unique in American schools, a chemical laboratory for students and he afterwards said: "I have always regarded it as one of the happiest events of my life that when a student in the University I was influenced by Professor Douglas to enter his laboratory for practical instruction." Undoubtedly his scientific interest was initiated here. He received the degree of bachelor of arts in 1859 and with intention of becoming a lawyer went to Germany in the autumn to begin his studies of jurisprudence in the University of Bonn.

Here he became acquainted with the professor in anatomy and, because of this contact, he began the study of anatomy. His keen interest in this caused him to forsake the law and begin the study of medicine. After two semesters in Bonn he went to Berlin where he continued his studies until 1862. In the meanwhile, the Civil War having broken out, he returned home to support the cause of the North.

Convinced of the advisability of completing his medical studies before enlisting, he entered the College of Physicians and Surgeons in New York and secured the degree of doctor of medicine in 1863. He was shocked at the laxity of method and requirement in the American schools as contrasted with his experience in Germany.

Securing a position as contract surgeon in the Army, he was stationed at Jefferson Barracks in Missouri where one gathers that he was disappointed by the routine character of the work and in three months he entered active service as assistant surgeon with the rank of first lieutenant. From this time until the end of the war his service was active and stirring. First in charge of a surgical ward in the hospital in Chattanooga, then of a smallpox hospital from which he viewed the Battle of Lookout Mountain; later, on the staff of General J. H. Wilson he rode with him on a raid through Alabama. Left behind to care for some wounded, he was captured by General Forrest but was soon released on parole. The war

ending, he left the Army returning to Detroit to take up the practice of his profession.

He thus started with a superb equipment, a technical and scientific training far better than usual, and with the initiative and confidence acquired by his varied military experience. Dr. McGraw's work in Germany had made him profoundly dissatisfied with American medical schools and in 1869 he, with others, founded the Detroit College of Medicine as a summer school. In 1871 he was invited to the chair of surgery in the University of Michigan which he occupied for one session. Here he found conditions similar to those existing in New York, with the exception of the laboratory work in chemistry. He had enough material for a weekly clinic but no hospital facilities. The endeavors of the faculty to make any change in this regard met with such determined opposition from the politicians that Dr. McGraw devoted his entire attention to the Detroit College of Medicine where he was professor of surgery until he retired. After the reorganization of this school in 1885 he became president and dean holding these positions until his retirement in 1915. In speaking of the impulses that led to these activities he says: "I had discovered in my two years of army activities that I was deficient in that exact knowledge of anatomy that was essential to good surgery. The advent of antiseptic and aseptic surgery, besides, had opened a new field for operative work, that of the abdomen, which demanded a study of anatomical relations, which had never been taught in the schools. . . . It seemed to me to be imperative, if I were to advance in my profession, that I should have facilities for dissections and other work that can be found only in a medical school."

He thus had the desire for self-improvement, to experiment and to teach, and to fulfil this desire he founded a medical school. From the first he was a voluminous writer and one cannot find a volume of the old medical journals as the *Peninsular Journal of Medicine* or *The Physician and Surgeon* without many case reports, clinical papers, and experimental observations from his pen.

He soon became a national figure because of his pioneer work in abdominal surgery, particularly intestinal anastomosis. In 1891, Dr. McGraw delivered the chairman's address before the section on surgery and anatomy of the American Medical Association upon "The Use of the Elastic Ligature in the Surgery of the Intestines" and his reputation became international. This work was no happy chance but was the result of several years of painstaking experimental work carried on with his assistants Hickey, Ives, Ireland, and Warren.

His writings show a wide acquaintance with scientific literature and a protean interest in surgery. Hardly a subject of surgery but what was illuminated by him, especially one notes his interest in cancer and intestinal obstruction. As an instance of his daring pioneer surgery, one recalls that he performed in 1882 one of the early thyroidectomies in this country. The patient afterward developed myxœdema which was a source of much chagrin to Dr. McGraw.

His success in teaching is attested by the large number of able men who secured their early training and enthusiasm at his hands and by the almost idolatrous worship they had for him. He always preached longer and more careful training for surgeons and condemned the attempt to operate without sufficient training and education. This attitude is best expressed in his own words: "Modern methods of surgery admit of such radical procedures that the young surgeon is inclined to lose respect for the human body. He thinks he can cut at will and produce sweeping cures immediately. . . . Special equipment should be required of the surgeon. The young graduate in medicine should not be permitted to exercise his zeal for operating until he has perfected himself through older men. I believe a law calling for a special degree would be of value."

In person, plainly but immaculately dressed, dignified and at times austere, but in his personal relations kindly and modest almost to a fault, he was ever sympathetic with the weak but quick to rebuke a wrong. Quiet reigned immediately on his entrance to a lecture room or clinic, and attention born of admiration and respect deepening, in the older students, into affection and love was probably the most notable feature of this association. To those who knew him well it was interesting to note the reaction of the occasional visitor or of one visiting his operative clinic for the first time. After the introductory remarks which always covered with a unique clarity the subject in hand, on picking up the scalpel his hand was seized with a tremor so marked that all unacquainted with him were concerned until the moment the blade came in contact with the operative field, when the firm and steady stroke dispelled the momentary doubt. His operating was marked by care and attention to detail quite in contrast to the spectacular and oftentimes brilliant workers of his time. Lack of consideration of a patient, or an apathetic or slovenly disposal of a case was certain to receive its well merited rebuke. With patients and colleagues alike he was ever the Christian gentleman, ready to give all he had of time, skill, and sympathy.

Following his retirement from active practice and teaching in 1915 he continued a lively interest in surgical literature and progress until his death in 1921 at the age of 82. No one can estimate the amount of good he did surgery by his honesty, inspiration, example, and scientific industry.

FREDERICK A. COLLER.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

ALFRED BROWN, M.D., F.A.C.S., Omaha, Nebraska

THE LETTERS OF JOANNUS MANARDUS

THE fame of a prominent physician of the early sixteenth century, especially if he was a professor in a well known school, spread far and wide. Consequently his knowledge and skill were often called for, but as distances were long and travel slow, it was difficult for him to attend in person and the practice of writing for opinions became quite common. The attending physician wrote a description of his patient's symptoms and inquired as to the diagnosis and treatment, hoping for an answer which would help him in his difficulty.

Joannus Manardus was often appealed to in this way and carried on a large and widely spread correspondence. These letters he saved and subsequently published. The first collection under the title *Medical Letters* appeared in 1521. In 1535 he published a larger collection "*Eighteen Books of Medical Letters* by Joannus Manardus Physician of Ferrara, at this time the most celebrated and learned in the doctrines of Galen and opinions of the Arabians of all the professors of Medicine in the whole of Italy. In part these are now corrected in many places by the author himself, in part now first published. There are added the annotations and criticisms of the simple and compound medicaments of Mesue." Basle 1535. A final collection consisting of twenty books appeared in 1540 and was republished as late as 1611.

The letters appearing in the collection of eighteen books were written between 1500, when he was living in Mirandola and serving as physician to Prince Giovanni Francisco Pico, and 1534 when he lived in Ferrara where he had succeeded Nicola Leoniceno in the University.

Though Manardus wrote a commentary on Galen which was first published in 1525 at Rome and republished 11 years later at Basle, his letters are his most important contribution to medicine and to a lesser extent to surgery. They give an intimate picture of the man and his ideas, for he seldom held to the matter at hand alone but elaborated as he went on, giving his opinions on many subjects, usually expressed clearly and frequently contrary to the prevalent dicta of the times. He lived during a period of the utmost standpattism in science. There was the greatest respect for the ideas of the ancients and their authority was considered incontrovertible. Yet Manardus places the results of observation above the authority of Hippocrates, Galen, and the Arabians, and in his opening letter, written in 1518 to Florianus Montinus, gives his reasons for publishing the letters and states this belief forcefully and without equivocation. He thus marks himself as a pioneer among the physicians of this early sixteenth century in discarding the dicta of tradition and initiating the revolt which was to lead to the renaissance of surgery. Not content with this revolt against established custom in science, he again breaks away; this time in another direction. In a period ruled by mysticism and superstition and a belief in the influence of stars over the human race, when astrologers were among the most influential servants of the crown, because the mind of man wished, if it dared, almost to go back to the gods of Olympus, sacrifice to them and consult the Oracle of Delphi—reading its omens in the entrails of the sacrificial beasts; yet, because of its so called intelligence, hardly daring to go to quite such lengths it must perforce content itself with reading omens in the stars, casting horoscopes, and attempting to cure disease with charms and amulets. Manardus comes forward with the statement: "It is well, therefore, both for themselves and the sick if the physicians take counsel how often the evacuation is seen, inspect urine rather than a star, and observe rather the pulsation of the vein than the configuration of the stars."

Manardus was evidently considered an authority on surgical matters for he writes in answer to questions concerning wounds of the head, where he makes a distinction between death due to a wound without fracture and death due to inter-current disease; the various types of wounds and fractures; congenital dislocation of the hip; tumor of the uterus; renal and vesical stone; and bleeding. From his answers he must be considered rather a surgical pathologist than an operator for, though he describes the symptoms and types of surgical conditions, he rarely advises operative therapy. Possibly his most important contribution to surgical nomenclature and diagnosis is his bald statement calling attention to the error of Serenus Sammonicus who had taught that elephantiasis and lepra were related to one another. He says "Also, one cannot keep silent concerning the error of many, following Simon, where he has stated that elephantiasis is a form of leprosy, when they are diseases greatly dissimilar." This, alone, stamps him as a good clinical observer.

IOANNIS MANARDI

MEDICI FERRARIENSIS, HAC AETATE
omnium medicinæ professorum per uniuersam Italiam,
in Galeni doctrina & Arabum censura
celeberrimi, & optime
meriti,
EPISTOLARVM Medicinalium
libri duodeuiginti.

Hi partim infinitis in locis & ab ipso autore iam recens castigati sunt, partim iam primum in lucem eduntur.

EIVSDEM annotationes & censura in medi
camina simplicia & composita
MESVE

Cum gratia & priuilegio Cæsareo

BASILEAE
M. D. XXXV.

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REVIEWS OF NEW BOOKS

A *HANDBOOK for the Diabetic*[1] is a new addition to the considerable number of acceptable guides for the use of diabetic patients and may be recommended as one of the best available. Intended for the use of the patient and dietitian as well as the physician, the presentation of the material is admirably clear and concise. The value of general routine yearly examinations in the recognition of diabetes is stressed. Emphasis is laid on the necessity of including in the diet sufficient vitamine and mineral content, and the amounts believed to be present in each food are included in the table of food analysis. WALTER H. NADLER.

THREE further volumes of the Lewis *Practice of Surgery*[2] are offered for review. Volume 1 deals exclusively with miscellaneous surgical topics such as diagnostic methods, anæsthesia, wounds, hæmorrhage, shock, diet, and the like, all of which are well covered. The chapter on surgical infections by Martin is a classical essay and deserves special comment. The thoroughly fundamental and scientific nature of this article marks a step distinctly forward for the clinician. If we expect to improve upon our present methods of treatment of the surgical infections it must be through the channels of more careful study of the underlying basic factors and the reaction of tissues to the invading organism as well as a study of the physiology and chemistry of the bacteria concerned. Attention should also be called to Hughson's two chapters on pre-operative preparation and postoperative care of the surgical patient. Although comparatively brief, these two articles breathe sincerity and enthusiasm. This phase of surgery needs to be elaborated upon because here one single factor may be the keynote to success or the cause for failure. In the preface of his book on *Fundamentals of the Art of Surgery* John H. Watson states:—"The more one sees of practical surgery the more is one impressed by the relative frequency of unforeseen complications and when one carefully thinks out the cause of these troubles it is only to find that most of them could be prevented." This significant fact is too often so tragically demonstrated when patients receive inefficient pre-operative preparation and postoperative care.

Volumes 10 and 11 are devoted to gynecology and are prepared by a number of well known gynecologists under the very able editorship of Cullen. The diseases peculiar to woman are very well covered, but certain chapters have an especial appeal because of the safe, sane, and practical attitude of the authors. This is exemplified by C. Jeff Miller's chapter on puerperal infection. This treacherous malady is a most important subject for the obstetrician and the general practitioner as well as for the abdominal surgeon. It is therefore pleasing and profitable to read this unusually lucid and scientifically sound treatise written by a man who has had a vast experience tempered by good judgment and acumen. The chapters by Martzloff on cervix uteri and by Gardner on ovarian tumors are very well written and complete. It is interesting to note the conservative attitude of King writing on organotherapy. His position is well taken, for he stands on the side of fairly definitely proved therapy.

The abdominal surgeon would like to know more about endometrial implants in the bowel wall. This process is not infrequently the cause of incomplete intestinal obstruction, and due to its gross characteristics it is often confused with carcinoma on the operating table. In many instances it is possible to make a tentative diagnosis before the operation, and the surgeon is then not led astray at the operation. There is grave doubt as to whether the subject will find its way into the system through any other channels except the gynecological.

In volume 11 the chapter by Hunner on right lower abdominal pain should find an inquisitive response. It appears that the right lower quadrant is becoming more of a mystery than is the right upper quadrant. This is because of the rapid development during recent years of the diagnostic procedures with special reference to detecting peptic ulcer, gallbladder, pancreatic, and duodenal disease. More study must be directed toward the right colon.

The two volumes cover the subject of gynecology in a complete and practical manner. The illustrations, many by Brödel, are excellent. These volumes are fit companions for volume 2 which was reviewed in June, 1928. JOHN A. WOLFER.

OF distinct interest, especially in those countries where the application of biological standards has only recently become a legal obligation, is Dr. Burn's new book[3] on methods of biological assay. It will be of value as a reference work in connection with the next revision of the pharmacopœia and in the adoption of international standards by the Health Section of the League of Nations. He gives detailed descriptions of methods used for the digitalis group, pituitary extract, insulin, arsenobenzene, ergot, adrenalin, ovarian hormone, parathyroid extract, and he mentions more briefly methods applicable to thyroid extract, atropine, and anterior lobe of the pituitary.

The reader cannot help but be impressed with the degree of care and skill and the corresponding expense in materials that are necessary to insure the

[1] A HANDBOOK FOR THE DIABETIC. By Albert H. Rowe, B.S., M.S., M.D. New York and London: Oxford University Press, 1928.

[2] PRACTICE OF SURGERY. Edited by Dean Lewis, M.D., Sc.D. Vol. i—Miscellaneous. Vols. x and xi.—Gynecology. Hagerstown, Maryland: W. F. Prior Company, Inc., 1928.

[3] METHODS OF BIOLOGICAL ASSAY. By J. H. Burn, M.A., M.D. (Camb.). With an Introduction by H. H. Dale, C.B.E., R.S., M.D., F.R.C.P. New York and London: Oxford University Press, 1928.

purity and potency of the drugs the physician uses. There is an admirable introductory chapter by H. H. Dale on the general subject of biological standardization. C. A. DRAGSTEDT.

THIS book of 661 pages on proctology[1] is highly recommended to those interested in the subject. Wide clinical experience and knowledge of pathological anatomy are everywhere in evidence in the text. The illustrations are numerous (417 in number) and well done. Obsolete procedures such as division of the valves of Huston for constipation are mentioned to be condemned. The treatment of the various lesions in the rectum is somewhat encyclopædic and the author's personal preference in the matter is not emphasized as much as this reader would have liked. The chapter on stricture of the rectum is excellent. The treatment of internal hæmorrhoids by injection is taken up in some detail. The author states that only 50 per cent are amenable to treatment and that "symptomatic relief and more or less permanent 'cure' results, the parts being left in a healthy condition and functioning normally." My feeling is that in the great majority of cases the treatment is purely palliative and in the hands of an inexperienced man results in frequent and occasionally serious complications. In the chapter on coccygodynia the importance of osteo-arthritis of the lower elements of the spine could properly have been emphasized.

From a surgical standpoint this book is sound and should receive a wide circulation. V. C. D.

THE title *Roentgenology; its Early History, Some Basic Physical Principles and the Protective Measures*[2] implies a work or treatise covering the subject of roentgenology. The title is misleading inasmuch as it deals only with a few phases of X-ray knowledge and is really an elaboration of the author's Caldwell lecture delivered in 1927 before the American Roentgen Ray Society. To this has been added material on certain phases of the physics of X-rays and some practical material regarding X-ray protection.

The first chapter of the book is a most interesting though somewhat brief exposition of the history of events which led up to the discovery of the X-ray by Roentgen in 1895. In another chapter the nature of X-ray is discussed and is ably presented with numerous references to the works of investigators, who have contributed to the knowledge of the physics of radiation. The subject is brought up to date, and sets forth the experimental findings and results obtained by modern physicists, among them in America being Millikan and Compton.

The author gives considerable space to the matter of X-ray protection. The regulations of various civic bodies on X-ray laboratory installations and requirement of government regulatory bodies are detailed, and recommendations are set forth which are of particular value to architects and constructors of our modern hospitals. Protection against undesired effects of radium to workers in this element is also considered.

In an appendix the author gives the official recommendations of the British X-ray and Radium Protection Committee, and a similar set of recommendations adopted by the second International Congress of Radiology in Stockholm in 1928 is presented.

The book contains much useful information for the student in X-ray physics. One might suggest that a more appropriate title could have been given this book, one that would be more specific of its contents than the broad and inconclusive term used, which gives the impression of a wider and more general consideration of the subject than it actually contains. E. S. B.

SICARD and Forestier have rendered a tremendous service to the medical profession by the introduction of lipiodol as an aid to diagnosis. New uses for it are being continually found and nowadays in many instances, in which the X-ray can be used as an aid to diagnosis of hollow cavities or vessels, etc., offers great assistance.

In their book *The Use of Lipiodol in Diagnosis and Therapeutics*[3] the authors discuss their own observations and those of others. Individual chapters are devoted to the use of lipiodol in diagnosis of lesions of the spinal cord and subarachnoidal spaces, of the tracheo-bronchial tree, of the genito-urinary apparatus, and to the exploration of blood vessels, abscesses and fistulæ, paranasal sinuses, lacrimal systems, and stomach and to such miscellaneous conditions as salivary glands, bones, joints, etc. In the chapter devoted to therapy, the therapeutic use of lipiodol in the epidural spaces, in certain joint conditions, in suppurative lesions of the bronchial tree, in cold abscess, etc., are discussed.

A very complete bibliography is appended.

The general construction of the book is excellent. The descriptions are clear and concise. Whenever a method of technique is described it is done so in such a way that it can be very easily followed. The book is profusely illustrated with excellent X-ray reproductions showing phases of most of the important variations, normal and pathological.

Every roentgenologist will want this book for his library if he has not already the original articles. However, it is not to the roentgenologists but to the profession in general that this book most appeals. Inasmuch as the use of lipiodol may be of diagnostic aid in almost every branch of medicine and surgery, as indicated by the titles of the chapters, this book will interest men working in many fields. The fact that it is written in a foreign language is not as great

[1] PROCTOLOGY; A TREATISE ON THE MALFORMATIONS, INJURIES AND DISEASES OF THE RECTUM, ANUS AND PELVIC COLON. By Frank C. Yeomans, A.B., M.D., F.A.C.S. New York: D. Appleton and Company, 1929.

[2] ROENTGENOLOGY; ITS EARLY HISTORY, SOME BASIC PHYSICAL PRINCIPLES AND THE PROTECTIVE MEASURES. By G. W. C. Kaye, O.B.E., M.A., D.Sc., F. Inst. P. New York: Paul B. Hoeber, Inc., 1928.

[3] DIAGNOSTIC ET THERAPEUTIQUE PAR LE LIPIODOL; CLINIQUE ET RADIOLOGIE. By J. A. Sicard and J. Forestier. Paris: Masson et Cie, 1928.

a drawback as might be expected because of the profuse illustrations. However, the reviewer is glad to note that the book will be speedily translated.

The reviewer considers the work of Sicard and Forestier as among the most important advances contributed to medicine in recent years and, therefore, this book is one which has not only practical but historic interest. R. B. B.

NEW installments of *Biology and Pathology of Woman*[1] edited by Halban and Seitz, have been appearing in a steady succession throughout the last year, and the gigantic work will soon be before us in its entirety.

The multiform clinical aspect of uterine fibroids is presented by Albrecht in an essay of 149 pages. Among the well known symptoms, menorrhagia and metrorrhagia are the most common and important signs. Postclimacteric bleeding may, in rare cases, be caused by harmless polyps; but more often it is due to a coexistent carcinoma or a sarcomatous degeneration of one or more of the fibroids. Disturbances of the heart or the metabolism, changes in the thyroid, or the development of constitutional anomalies are often attributed to the uterine tumors. Albrecht warns against an uncritical acceptance of such statements. He points out that in the fourth and fifth decades of life all these alterations are quite as common in women without fibroids and he is inclined to believe that in patients with fibroids the combination may be purely accidental. The harmful effect of fibroids on the heart in particular is far from being proved. Valvular lesions are always caused by factors other than fibroids. Myocarditis can be considered secondary to fibroids only if the tumors are very large (brown atrophy) or the anæmia most pronounced (fatty degeneration). Cardiac dilatation is merely the result of anæmia and may correct itself after the bleeding has been checked permanently. In functional disorders of the heart, the connection with fibroids has not been established; it would be more permissible to seek the connection in a dysfunction of the ovaries. The frequent rise in blood pressure bears, likewise, no regular relation to fibroids; and it is noteworthy that it usually remains high after the elimination of the tumors or uterus. The interesting though scant literature on hereditary transmission of fibroids is discussed; as is also the question of fibroids and fertility.

Of the section on diagnosis, only the data on necrosis of fibroids in pregnancy and puerperium may here be mentioned. In this complication which manifests itself by signs of peritoneal irritation and fever the author advises early operation rather than waiting until chills and progressive peritonitis indicate infection and presage a very doubtful prognosis.

As to the question when to operate and when to use radium in the treatment of fibroids, Albrecht professes views very similar to those enunciated by the reviewer[2] to which the author also refers in the bibliography. This bibliography, by the way, covers many pages of fine print and contains numerous references from American literature. While surgical therapy is given a wide field, yet the fact that there is an operative mortality of at least 3 per cent must warn us against careless indications. Discussing the *pros* and *cons* of supravaginal amputation, the author considers the chance of carcinomatous degeneration of the cervical stump as practically negligible. With this statement the reviewer, from a fairly extensive personal experience, cannot agree. It is, however, the only statement which he would question; for this treatise is an admirable piece of literary work which far transcends the limits of a textbook article and delves deeply into all phases of a subject of immense practical importance.

The discussion of treatment of fibroids is continued by v. Seuffert who attacks the subject from the standpoint of the gynecological radiologist. The author whose excellent textbook on deep radiotherapy in gynecology was reviewed in this journal some 6 years ago, considers both fibroids and nonmalignant hæmorrhages. He gives credit to Wickham, of New York, who, in 1906, was the first to use radium for climacteric bleeding. The dosage, the safety, the indications and contra-indications, the effects and by-effects, and finally, the technique are some of the subheadings of this contribution which gives to the reader a very good survey of this burning question. The author does not believe that the germ plasma can be injured by properly applied X-ray or radium treatment but warns against the use of these agents after conception has taken place. He expresses himself with due caution as to whether or not radiation is suitable for the relief of sterility, an attitude with which most gynecologists will be in full accord.

The same installment contains an article, again from the pen of Albrecht, on the pathology and clinical aspect of sarcoma of the uterus. Contrary to exaggerated estimates, sarcomatous degeneration of fibroids takes place only in about 1 per cent. Its frequency compared with that of carcinoma is 1 in 30 or 1 in 50. After a description of the macroscopic and microscopic characteristics of sarcomata, the question of the most promising treatment is discussed. Unfortunately, neither surgery nor radiation yield encouraging results. By and large, deep X-ray therapy is, perhaps, a little better since it is at least not encumbered with any operative mortality. On the other hand, diffuse formation of metastases seems to follow this form of treatment all too quickly.

Lahm contributes three chapters on the histopathology of mixed tumors (lipoma, myxoma, angioma, etc.), adenoma and carcinoma of the uterus, respectively. These chapters which are not suited for detailed reviewing, are illustrated with

[1] Biologie und Pathologie des Weibes; ein Handbuch der Frauenheilkunde und Geburtshilfe. Edited by Josef Halban and Ludwig Seitz. Lieferungen 27, 32, 36, 38, 39, 40, 41. Berlin and Vienna: Urban & Schwarzenburg, 1928, 1929.

[2] J. Am. M. Ass., 1922, lxxviii, 259.

numerous photomicrographs and reflect the wide experience of the well known author who is one of the leaders among the younger German gynecological pathologists. They furnish an excellent basis for a thorough study of the conditions named.

There follows a chapter in which Kermauner deals with the clinical aspect and the operative treatment of the various forms of cancer of the uterus, and another chapter which Eymer devoted to radiotherapy of uterine cancer. The presentation of these subjects is so complete that the reader, who has some experience of his own, is enabled to draw his own conclusions in a matter which is still in the center of discussion.

Turning at random to another installment, we find a monograph on the biology and pathology of pregnancy and labor in domesticated animals written by Keller. The inclusion of this subject in the great reference work has obvious advantages. It represents a bridge between human and veterinary medicine across which fruitful suggestions can be exchanged. The modern gynecologist for whom this work has been created, will widen his biological horizon by learning of normal and deranged functions of reproduction in animals, and one who contemplates animal experimentation, can save much time and effort by studying this essay of a recognized authority.

Latzko and Schiffmann fill an entire installment with an essay on the relations of the urinary apparatus to the female generative organs. This contribution with its 355 pages, 67 illustrations, and 8 colored plates represents a complete textbook on gynecological urology. Kolischer, of Chicago, was the pioneer in this field. Methods of examination and diagnosis form the first part. Then follow diseases of the female urethra. Of these, stricture is considered more frequent by American than by German authors. In the extensive section on diseases of the bladder, the special significance of this organ in the field of obstetrics and of gynecology is given due prominence. The authors show how much the surgery of the ureters has been improved by gynecologists. It may be questioned whether the detailed presentation of anomalies and diseases of the kidney (almost 100 pages) rightly belongs in a gynecological work. Much of it should be reserved for the urologic specialist. On the other hand, problems of differential diagnosis, the question of pyelitis in pregnancy, gestation after nephrectomy, hypernephromatous metastases within the genital sphere, etc., directly concern the gynecologist. From this point of view the inclusion of the various kidney lesions is of definite value to us. It may be mentioned incidentally that the American literature is very fully considered in this contribution.

Other borderline subjects are taken up by Novak. There is, for instance, an article on the relations between the eye, ear, nose, and throat, and the genitals, another on the reciprocity with muscles, bones, and the gastro-intestinal tract, a third on infectious diseases, still others on the nervous system and the skin in their relations to the female generative sphere. One is amazed at the thoroughness and encyclopedic knowledge of the author who has collected scattered reports from all the world and welded them into compact presentations of the respective subjects under discussion. Let me select, as an illustration, his chapter on the interrelations of skin and female genitals. It has 89 pages with 11 pages of bibliography and numerous excellent photographs in natural colors and in black and white. I began by glancing at it as a subject little known to me, and ended only after I had read every word most attentively. I found the study of absorbing interest and full of suggestions as to further practical investigations, and I believe that this will be the reaction of most other readers who, like myself, have been all too much immersed in mere organ pathology.

This review may be closed with a brief reference to the admirable article by Neurath on the physiology and pathology of puberty. This important phase in the development of woman has thus far not received a monographic consideration. The author presents instructive tables illustrating the time of first menstruation, the growth and development of the body as a whole, and of the various organs and tissues. A comparison between boys and girls shows that at the age of 8 to 10, boys, on an average, are taller and heavier than girls. Toward the end of the tenth year, girls take the lead both as to height and weight, but after the fifteenth year they are again exceeded by boys, and from then on remain permanently below them. Body growth ceases when sexual maturity is complete, that is, in man at 23, in woman at 18 years. Pigmentation of the skin bears some relation to puberty. Certain tribes extirpate the ovaries in their young girls; in these the perineum, anal region, and axillæ remain white. (This fits in with the observation of kraurosis in young women with insufficiency of the ovaries.) The chapter on the development of the psyche in puberty is beautifully written and deepens our understanding of the adolescent girl. Of the general pathology, morbidity, and mortality of puberty, only precocious puberty may here be mentioned; the relation of girls to boys in this connection is 3½ to 1.

The storm and stress period of puberty is, as a rule, little understood by parents and educators, and the physician is often consulted for manifestations which may be wholly physiological. The study of this essay will help him to act as a sympathetic friend and adviser. GEORGE GELLHORN.

THE volumes included in *Précis de Pathologie Chirurgicale*[1] constitute the official "Quiz compends" used by members of the French faculties of medicine preparatory to their examinations for professorship. The same terse sentences are used

[1] PRÉCIS DE PATHOLOGIE CHIRURGICALE. Vols. i to vi. By P. Begouin, F. Papin, Henri Bourgeois, Pierre Duval, J. Gatellier, A. Gosset, D. Petit-Dataillis, E. Jeanbrau, P. Lecene, Ch. Lenormant, R. Proust, R. Soupault, L. Tixier, and M. Patel. 5th ed. completely rev. Paris: Masson et Cie, 1928.

throughout, all known facts are logically correlated, and there has been a most successful attempt to eliminate old surgical barnacles. As a quick reference series or a vade-mecum for younger surgeons who have, at least, a working knowledge of the French language these volumes can be heartily recommended. They represent the best thoughts of French surgeons. Each subject is treated under identical subheads, i.e., etiology, pathologic anatomy, symptoms, and diagnosis and treatment. The index is admirable. Volume 1 deals with general surgical pathology and diseases of tissues in general. Modern ideas of biology, biochemistry, and physiology are tersely brought out. Volume 2 is devoted to surgical diseases of the head, brain, and spinal cord. Volume 3 includes the neck, thorax, and mammary glands. Volume 4 is entirely devoted to surgery of the abdominal contents. Volume 5 discusses male genitalia, the genito-urinary tract, and general gynecology. The final volume is entirely reserved to the treatment of fractures.

The only criticism which can be justly made is to accuse the authors of being, not infrequently, too intensely nationalistic. Very few "foreign" contributions are mentioned. The six volumes represent the present day opinions of French surgeons, almost exclusively based on experimental or clinical observations of French coworkers. One is somewhat startled, for instance, to find that, in the chapter on inguinal hernia, the name of E. Wyllys Andrews is not mentioned! Many other omissions can be noted and one can only hope that, some day, the classical dictum of French teachers to their students to "opérer à la Française" may be replaced by a more international viewpoint. GEORGE DE TARNOWSKY.

THERE is an abundance of facts in the little volume on *The Causes of Ante-Natal, Natal and Neo-Natal Mortality of Infants; with Special Reference to South India*.[1] Since statistics in India are difficult to obtain those put forth in this volume are valuable in throwing light on obstetrical conditions in Madras. It is interesting to note that one-third of the births take place in the hospital.

The maternal mortality rate is close to two and one-half per cent in the two hospitals studied. This, of course, is quite high, but the author gives the inference that undernourishment is a factor. This explains some of the mortality in infants as many are born prematurely.

The author says that the large majority of stillbirths and neo-natal deaths are due to ante-natal causes. Syphilis is very prevalent.

The author says: "It may be generally stated that the greater the number of cæsareans performed by an obstetrician, the less is he competent to arrive at a sound obstetric judgment." Just why cæsarean section should cloud the judgment, and not forceps operation or version and extraction, is hard to understand.

It is interesting to note that in 64,000 confinements there were 2 cases in the 12th year; 18 in the 13th; 87 in the 14th; and 307 in the 15th year. While "early maternity" does occur it is not as common as a recent lay publication would lead us to believe.

This booklet is well worth reading.

EDWARD L. CORNELL, M.D.

ROBINSON and Jamieson's *Surface Anatomy*,[2] as its preface states, is intended for the student dissector. When used along with the systemic anatomy and dissector as collateral reading there is probably no book now published which approaches it in excellence. Certainly, for thoroughness in material presented and for clearness of presentation it ranks with the best in topical anatomy. No attempt has been made to include clinical applications of the relationships presented, and while the addition of practical applications might enhance the book for the surgeon, opinions differ as to their value to the beginning medical student. The book differs somewhat from the usual exposition of surface anatomy in that each region is taken up systemically so that each structure is described in its entirety and in continuity, getting away from the confusing cross-sectional manner of presenting surface relations. The 38 illustrations are well chosen, but it is felt that a number more could be added to advantage. The absence of any but incidental reference to the genital organs is unique. The book will find its greatest use in the dissecting room, though it would doubtless be a valuable reference text for the clinical teacher in courses of physical diagnosis. MICHAEL L. MASON.

THE recent publication by *Pauchet and Dupret*[3] is a pocket atlas in size only, for actually it contains 297 excellent diagrammatic plates which illustrate surprisingly well the whole of human anatomy. The plates are arranged by regions so that ready reference to any structure is quite easy. There is no descriptive text and the figures are labeled directly on the plate without the necessity of referring to legends. The last 21 illustrations of lymphatic drainage present in a clear and non-confusing manner the main pathways with which the surgeon is concerned. It is believed by the reviewer that the addition of several plates would increase the value of a new edition. These plates might well include a more detailed and larger diagram of the inguinal region with reference to hernial repair; a plate of the abdominal wall to show the muscular layers with reference to the usual incisions; illustrations of the fascial spaces of the shoulder, axilla, and hand; and a series of sectional views of the joints. A diagrammatic view of the

[1] THE CAUSES OF ANTE-NATAL, NATAL AND NEO-NATAL MORTALITY OF INFANTS; WITH SPECIAL REFERENCE TO SOUTH INDIA. BEING THE ELIZABETH MATHAI LECTURES DELIVERED UNDER THE AUSPICES OF THE UNIVERSITY OF MADRAS AT THE GIFFORD SCHOOL OF OBSTETRICS. By A. Lakshmanaswami Mudaliar, B.A., M.D. Madras: Associated Printers, 1928.

[2] OXFORD MEDICAL PUBLICATIONS: SURFACE ANATOMY. By Arthur Robinson, M.D., F.R.C.S., and E. B. Jamieson, M.D., New York: William Wood and Company, 1928.

[3] OXFORD MEDICAL PUBLICATIONS: POCKET ATLAS OF ANATOMY. By Victor Pauchet and S. Dupret. New York: William Wood and Company, 1929.

entire urinary tract from prostate to kidney would also be valuable. The book can be sincerely recommended as a rapid reference atlas which would always be most welcome in the surgeon's dressing locker where it could be consulted in a few moments.

MICHAEL L. MASON.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THE ORIGIN OF MALIGNANT TUMORS. By Theodor Boveri. Translated by Marcella Boveri. Baltimore: The Williams and Wilkins Company, 1929.

NEW AND NONOFFICIAL REMEDIES, 1929. Containing Descriptions of the Articles which Stand Accepted by the Council on Pharmacy and Chemistry of the American Medical Association on January 1, 1929. Chicago: American Medical Association, 1929.

THE SCIENCE AND PRACTICE OF SURGERY. By W. H. C. Romanis, M.A., M.B., M.Ch., (Cantab), F.R.C.S. (Eng.), F.R.S. (Edin.), and Philip H. Mitchiner, M.D., M.S. (Lond.), F.R.C.S. (Eng.). Vols. i and ii. 2d. ed. New York: William Wood and Company, 1929.

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PRINCIPLES AND PRACTICE OF MINOR SURGERY; A TEXTBOOK FOR STUDENTS AND PRACTITIONERS. By Edward Milton Foote, A.M., M.D., and Edward Meakin Livingston, B.Sc., M.D. 6th. ed. New York and London: D. Appleton and Company, 1929.

A HISTORY OF THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY. By P. M. Ashburn, Colonel, Medical Corps, U. S. Army, with an Introduction by Surgeon General Merritte W. Ireland. Boston and New York: Houghton Mifflin Company, The Riverside Press, Cambridge, 1929.

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INTERNATIONAL CLINICS; a Quarterly of Illustrated Clinical Lectures and Especially Prepared Original Articles on Treatment, Medicine, Surgery, etc. Edited by Henry W. Cattell, A.M., M.D., with the collaboration of others. Vol. ii. Thirty-ninth Series, 1929. Philadelphia and London: J. B. Lippincott Company, 1929.

METHODS AND PROBLEMS OF MEDICAL EDUCATION (Twelfth Series). New York: Rockefeller Foundation, 1929.

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THE NOSE, THROAT, AND EAR AND THEIR DISEASES; IN ORIGINAL CONTRIBUTIONS BY AMERICAN AND EUROPEAN AUTHORS. Edited by Chevalier Jackson, M.D., Sc.D., LL.D., F.A.C.S., and George Morrison Coates, A.B., M.D., F.A.C.S. Philadelphia and London: W. B. Saunders Company, 1929.

PRINCIPLES AND PRACTICE OF ELECTROCARDIOGRAPHY. By Carl J. Wiggers, M.D. St. Louis: The C. V. Mosby Company, 1929.

OSTEOMYELITIS AND COMPOUND FRACTURES AND OTHER INFECTED WOUNDS; TREATMENT BY THE METHOD OF DRAINAGE AND REST. By H. Winnett Orr, M.D., F.A.C.S. St. Louis: The C. V. Mosby Company, 1929.

THE CONQUEST OF CANCER BY RADIUM AND OTHER METHODS. By Daniel Thomas Quigley, M.D., F.A.C.S. Philadelphia: F. A. Davis Company, 1929.

COLLECTED PAPERS OF THE MAYO CLINIC AND THE MAYO FOUNDATION. Edited by Mrs. M. H. Mellish, Richard M. Hewitt, B.A., M.A., M.D., and Mildred A. Felker, B.S. Vol. xx, 1928. Philadelphia and London: W. B. Saunders Company, 1929.

OTOSCLEROSIS; A RÉSUMÉ OF THE LITERATURE TO JULY, 1928: COMPILED UNDER THE DIRECTION OF THE COMMITTEE ON OTOSCLEROSIS, AMERICAN OTOLOGICAL SOCIETY. By Norval H. Pierce, M.D., James F. McKernon, M.D., Eugene A. Crockett, M.D., J. Gordon Wilson, M.D., Arthur B. Duel, M.D., Editor. Vols. i and ii. New York: Paul B. Hoeber, Inc., 1929.

THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY IN THE WORLD WAR, VOL. x—Neuropsychiatry in the United States by Col. Pearce Bailey, M.C., Lieut. Col. Frankwood E. Williams, M.C., and Sergt. Paul O. Komara, M.D.; In The American Expeditionary Forces by Col. Thomas W. Salmon, M.C., and Sergt. Norman Fenton, M.D. Prepared Under the Direction of Maj. Gen. M. W. Ireland. Washington: U. S. Government Printing Office, 1929.

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THE MEDICAL MUSEUM: MODERN DEVELOPMENTS, ORGANISATION AND TECHNICAL METHODS BASED ON A NEW SYSTEM OF VISUAL TEACHING. By S. H. Daukes, O.B.E., M.D., D.P.H., D.T.M. & H. London: The Wellcome Foundation, Ltd., 1929.

GYNECOLOGY; A TEXT-BOOK OF THE DISEASES OF WOMEN. By Lynn Lyle Fulkerson, A.B., M.D., F.A.C.S. Philadelphia: P. Blakiston's Son & Company, 1929.

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PATHOLOGICO-ANATOMICAL AND CLINICAL INVESTIGATIONS OF FIBRO-ADENOMATISIS CYSTICA MAMMAE AND ITS RELATION TO OTHER PATHOLOGICAL CONDITIONS IN THE MAMMA, ESPECIALLY CANCER. By Carl Semb. Oslo, Norway: Nationaltrykkeriet, 1928.

THE CLINICAL ASPECTS OF VENOUS PRESSURE. By J. A. E. Eyster, B.Sc., M.D. New York: The Macmillan Company, 1929.

AMERICAN COLLEGE OF SURGEONS

TREATMENT OF MALIGNANT DISEASES WITH RADIUM AND X-RAY

REPORT OF THE COMMITTEE ON THE TREATMENT OF MALIGNANT DISEASES WITH RADIUM AND X-RAY OF THE AMERICAN COLLEGE OF SURGEONS

ROBERT B. GREENOUGH, M.D., F.A.C.S., BOSTON, CHAIRMAN

REPORT NO. II. — CANCER OF THE CERVIX

THE accompanying report is that of a committee appointed by the American College of Surgeons in February, 1922, and is supplementary to the first report of that committee on cancer of the cervix of the uterus which was published July, 1924, in SURGERY, GYNECOLOGY AND OBSTETRICS.[1]

The members of the Committee are as follows: A. C. Broders, Rochester, Minnesota; C. F. Burnam, Baltimore; G. W. Crile, Cleveland; Bowman C. Crowell, Chicago; William Duane, Boston; Edwin C. Ernst, St. Louis; J. M. T. Finney, Baltimore; Burton J. Lee, New York; Frank Lynch, San Francisco; R. T. Miller, Jr., Baltimore; H. K. Pancoast, Philadelphia; H. Gideon Wells, Chicago; Francis Carter Wood, New York; and Robert B. Greenough, Boston.

The 1924 report of the Committee on the "Treatment of Cancer of the Cervix" could be carried only to a three-year minimum of end-results, but at the request of the Board of Regents this report was published with the understanding that a supplementary report on a five year end-result basis would be made at a later date. The material which follows represents the data obtained by the Committee for this purpose.

The 1924 report recorded 94 cases of cancer of the cervix free from evidence of disease for a period of three or more years after treatment. Through the reporters from the various clinics from which the original records were obtained, efforts were made to obtain information in regard to the further history of these patients with the following results: 4 cases recorded as well at 3 years, but under 5 years, could not be further traced. One case alive and well at 3 years, died without recurrence before 5 years had elapsed, and 2 cases alive and well over 3 years, died subsequently of causes unknown. These cases have been omitted from the series as inconclusive[2] making a total of 7 cases to be deducted from the original 94, leaving 87 cases of the original series to form the basis of this report. It may be stated here that some 16 cases reported "untraced" in 1924 have since been traced and 9 of them found to be alive and well at periods of over 5 years. These cases, however, are not included in the series as they were not counted in the 1924 report. They include, however, 12 cases of hysterectomy with or without radium, with 7 alive and well over 5 years; 1 case of Percy cauterization, well 12 years; 1 case of excision of the cervical stump left after supravaginal hysterectomy well after 5½ years; and 2 cases of radium alone, both failures. Of this total of 87 cases here recorded as alive and well over 5 years, 12 have not been traced since 1924. All of these, however, had then (in 1924) passed a minimum period of 5 years and they have been included in the present series. Sixteen of the 87 cases recorded as alive and well in the 1924 series have died of cancer since that time, and the remaining 71 cases have remained well for varying periods from 5 to 13 years from the date of treatment. These 71 cases

[1]These two reports are based upon 1210 case records collected from the following hospitals: (1) Free Hospital for Women, Boston, Dr. W. P. Graves; (2) Huntington Hospital, Boston, Dr. G. A. Leland; (3) Massachusetts General Hospital, Boston, Dr Lincoln Davis; (4) Augustana Hospital, Chicago, Dr. Henry Schmitz; (5) Cook County Hospital, Chicago, Dr. Henry Schmitz; (6) German-American Hospital, Chicago, Dr. Henry Schmitz; (7) Post-Graduate Hospital, Chicago, Dr. Henry Schmitz; (8) St. Mary's Hospital, Chicago, Dr. Henry Schmitz; (9) St. Joseph's Hospital, Chicago, Dr. Henry Schmitz; (10) Washington Boulevard Hospital, Chicago, Dr. Henry Schmitz; (11) Frances Willard Hospital, Chicago, Dr. Henry Schmitz; (12) Roosevelt Hospital, New York, Dr. Howard C. Taylor; (13) University Hospital, Philadelphia, Dr. John G. Clark; (14) Philadelphia General Hospital, Philadelphia, Dr. Chas. P. Norris; (15) Scranton Hospital, Scranton, Pennsylvania, Dr. J. M. Wainwright; (16) Presbyterian Hospital, New York, Dr. James A. Corscaden; (17) Toronto General Hospital, Toronto, Dr. Alexander Primrose; (18) Howard A. Kelly Hospital, Baltimore, Dr. Curtis F. Burnam; (19) Jefferson Hospital, Philadelphia, Dr. B. A. Anspach; (20) Woman's Hospital, New York, Dr. George Gray Ward; (21) Memorial Hospital, New York, Dr. William P. Healy; (22) Lakeside Hospital, Cleveland, Dr. George W. Crile; they include only cases treated in the years 1914–1919, inclusive.

[2]It may be noted that of the 7 cases thus omitted, 4 were treated by hysterectomy alone, 2 by radium alone and one by cautery and ligation of the internal iliacs.

TABLE I.—TOTAL RECORDS RECEIVED, REJECTED, AND ACCEPTED FOR STUDY

Total cards received		1,210
Discards, first report, 1924		
Untraced	159	
Not cancer of cervix	10	
No treatment	56	
No pathological diagnosis	32	
Under 3 years	25	
Re-entries—duplicates	23	
1913 and 1920–1921–1922	43	
No data to classify	13	
Otherwise inconclusive	20	381
Satisfactory for study, 1924		829
Discards, second report, 1928		
Untraced 5 years	4	
Died—cause unknown 6 and 7 years after treatment	2	
Died without recurrence after 3 and before 5 years	1	7
Satisfactory for study, 1928		822

TABLE II.—FIVE YEAR END-RESULTS, 1928

1924 report—alive and well over 3 years		94
Deducted as inconclusive—		
Died without recurrence after 3 and before 5 years	1	
Died, cause unknown, well, respectively, 6 and 8 years	2	
Well 3 years, untraced after 5 years	4	7
1924 "cures" traced 5 years or more		87
Died of cancer after 3 years		16
Alive and well 5 years or more		71
Primary cases alive and well over 5 years after hysterectomy	27	
Primary cases alive and well over 5 years after radium without hysterectomy	33	
Recurrent cases	11	
		71

include the following: 11 are cases of recurrence after hysterectomy. This includes all of the cases recorded as free from disease in 1924. The remaining 60 are cases of primary cancer of the cervix, 27 of which were treated by hysterectomy, and 33 with radium without hysterectomy.

There were 142 hysterectomies performed in the 681 primary cases of the 1928 report: 123 were pan-hysterectomies by the Wertheim technique—9 were recorded only as abdominal hysterectomy; in 6 cases only a supravaginal hysterectomy was done; and in 4 cases a vaginal hysterectomy was performed. It is to be noted that 2 of the 4 vaginal hysterectomies gave successful 5 year end-results, while the remaining 25 successful results from operation were all obtained by the Wertheim pan-hysterectomy operation.

It was necessary to reject 381 records of the total number of 1,210 in both the 1924 and the

TABLE III.—COMPARISON OF END-RESULTS IN 1924 AND 1928

	1924			1928		
Primary cases	Cases	"Cures"	Per cent	Cases	"Cures"	Per cent
1A	123	35	28	119	25	21
1B	120	22	18	119	18	15
1C	310	24	8	308	15	5
1D	135	2	1	135	2	1
	688	83	12	681	60	9
Recurrent cases 2 and 3	123	9	7	123	9	7
Cervical stump	18	2	11	18	2	11
	829	94	11	822	71	9

TABLE IV.—LENGTH OF FOLLOW-UP IN SIXTY "CURED" PRIMARY CASES, 1928

Years	All treatments	Hysterectomy with or without radium	Radium with or without cautery
5– 6	11	5	6
6– 7	9	1	8
7– 8	3	2	1
8– 9	8	3	5
9–10	8	3	5
10–11	12	6	6
11–12	3	2	1
12–13	4	3	0
13–14	2	2	1
Total	60	27	33

Average follow-up 1924: 60 months or 5 years.
Average follow-up 1928: 104 months or 8 years 8 months.

1928 reports. The reasons for discarding these records are stated in Table I.

Thirty-two cases were rejected as they lacked pathological evidence of the presence of cancer; these cases were, however, all alive and well for the stipulated period after treatment.

Twenty-five cases were rejected because less than the stipulated period had elapsed from the time of the last treatment; these cases also were alive and well.

Five cases, however, were accepted in the 1924 report as three year "cures" in which a period of 3 years had not elapsed after the last treatment with radium. These were all cases in which the original treatment was given more than 3 years before, and the later radium treatment was given, without evidence of recurrence, only as a prophylactic measure. One of these was a case of hysterectomy with postoperative prophylactic radiation, one, cautery and radium, and three were treated by radium alone.

Eight hundred and twenty-nine cases (829) remained as satisfactory for study in 1924 and eight hundred and twenty-two (822) in 1928.

Table I is a tabular presentation of the rejected and accepted records.

Table II shows the survivals on the 5-year end-result basis.

TABLE V.—RESULTS OF TREATMENT, GROUP 1A

	1924			1928		
	Cases	"Cures"	Per cent	Cases	"Cures"	Per cent
Cases in Group 1A	123	35	28	119	25	21
Hysterectomy without radium	41	14	34	38	7	18
8 operative fatalities			19			
Hysterectomy with radium	28	9	32	28	8	28
Pre-operative radium	13	4	30	13	3	23
3 operative fatalities			23			
Postoperative radium	15	5	33	15	5	33
No fatalities						
Hysterectomy with X-ray	2	0	0	2	0	0
Hysterectomy with or without radium	71	23	32	68	15	22
Radium alone	30	5	16	30	4	13
Radium with cautery and X-ray	14	6	42	14	6	42
Radium with or without cautery	44	11	25	44	10	23
Other treatments	8	1	12	7	0	0

TABLE VI.—RESULTS OF TREATMENT, GROUP 1B

	1924			1928		
	Cases	"Cures"	Per cent	Cases	"Cures"	Per cent
Cases in Group 1B	120	22	28	119	18	15
Hysterectomy without radium	16	4	25	15	3	20
6 operative fatalities			37			
Hysterectomy with radium	15	5	33	15	4	27
Pre-operative radium	6	3	50	6	2	33
1 operative fatality			16			
Postoperative radium	9	2	22	9	2	22
No fatalities						
Hysterectomy with or without radium	31	9	29	30	7	23
Radium alone	56	6	10	56	4	7
Radium with cautery	21	7	33	21	7	33
Radium with or without cautery	77	13	16	77	11	14
Other treatment	12	0	0	12	0	0

Table III records the end-results as published originally in the report of 1924 and as they must be modified in the table of 1928. It will be noted that the percentage of all cases alive and well on a five year minimum follow-up has dropped from 11 to 9 per cent.

Table IV shows the length of the follow-up in the 60 "cured" primary cases of the 1928 report. It will be noted that "cures" both after hysterectomy and after radium treatment of more than 10 years' duration are in evidence, although above 10 years the number of "cures" after hysterectomy exceed those after radium to a slight extent. The average period of follow-up for the 1924 series was 5 years, and for the 1928 series the average is 8 years and 8 months.

It is interesting to note that although "late recurrence" such as occurs in cancer of the breast is rare in cases of cancer of the cervix, one case in this series was free from all evidence of disease 7½ years after treatment with radium, but died of recurrence 10½ years after treatment.

TABLE VII.—RESULTS OF TREATMENT, GROUPS 1A AND 1B COMBINED

	1924			1928		
	Cases	"Cures"	Per cent	Cases	"Cures"	Per cent
Cases in Groups 1A and 1B	242	57	23	237	45	19
Hysterectomy without radium	57	18	31	53	10	19
14 operative fatalities			21			
Hysterectomy with radium	43	14	32	43	12	28
Pre-operative radium	19	7	36	19	5	26
4 operative fatalities			21			
Postoperative radium	24	7	29	24	7	29
No fatalities						
Hysterectomy with X-ray	2	0	0	2	0	0
Hysterectomy with or without radium	102	32	31	98	22	22
Radium alone	86	11	12	86	8	9
Radium with cautery or X-ray	35	13	37	35	13	37
Radium with or without cautery	121	24	19	121	21	17
Other treatment	19	1	5	18	0	0

Table V represents the results of various forms of treatment in the group of 1A cases (those in which the disease is confined to the cervix itself). It is interesting to note that the percentage of "cures" obtained after hysterectomy with or without radium has dropped from 32 to 22 per cent, whereas the percentage of "cures" obtained by radium with or without cautery or other palliative operation is now practically the same, 23 per cent. It also appears that hysterectomy aided by radium, either before or after operation, gave better results than hysterectomy alone.

Table VI gives the results of treatment in the 1B group or border-line cases, in which some extension of the disease has taken place, but in which the broad ligaments are not involved. In this group the "cures" by hysterectomy have dropped from 29 to 23 per cent and those by radium from 16 to 14 per cent.

Table VII deals with the 1A and 1B groups combined and shows a falling off of the "cures" after hysterectomy from 31 to 22 per cent, and after radium from 19 to 17 per cent. In groups 1A and 1B it is apparently the cases which were treated by hysterectomy rather than those treated with radium, which have shown the most marked falling off in the number and percentage of successful cases as the follow-up period is extended. This is in contrast to the results in the 1C group as will appear in the next table. In considering Table VII we must remember that in these groups hysterectomy with or without radium gave an operative mortality of 18 per cent.

TABLE VIII.—RESULTS OF TREATMENT, GROUP 1C

	1924			1928		
	Cases	"Cures"	Per cent	Cases	"Cures"	Per cent
Cases in Group 1C	310	24	7	308	15	5
Hysterectomy without radium.	13	1	7	13	1	7
2 operative fatalities			15			
Hysterectomy with radium	25	4	16	25	4	16
Pre-operative radium	19	3	16	19	3	16
No fatalities						
Postoperative radium	6	1	16	6	1	16
No fatalities						
Hysterectomy with or without radium	38	5	13	38	5	13
Radium alone	189	12	6	187	4	2
Fatalities	1	..	0.5	1	..	0.5
Radium and cautery or X-ray	52	7	13	52	6	11
Radium with or without cautery	241	19	7	239	10	4
Cautery alone	22	0	0	22	0	0
Other treatment	9	0	0	9	0	0

TABLE IX.—RESULTS OF TREATMENT, GROUP 1D

	1924			1928		
	Cases	"Cures"	Per cent	Cases	"Cures"	Per cent
Cases in Group 1D	135	2	1	135	2	1
Hysterectomy without radium	4	0	0	4	0	0
Hysterectomy with radium	2	0	0	2	0	0
Hysterectomy with or without radium	6	0	0	6	0	0
Radium alone	88	1	1.1	88	1	1.1
Radium with cautery	27	1	3	27	1	3
Radium with or without cautery	115	2	1.7	115	2	1.7
Other treatment	14	0	0	14	0	0

TABLE X.—RESULTS OF TREATMENT IN CASES OF RECURRENCE AFTER HYSTERECTOMY.

	1924			1928		
	Cases	"Cures"	Per cent	Cases	"Cures"	Per cent
Recurrences after hysterectomy	141	11	8	141	11	8
Recurrent after hysterectomy	123	9	7	123	9	7
By radium alone		7			7	
By radium and cautery		2			2	
Cancer of the cervical stump	18	2	11	18	2	11
By radium alone		2			2	

The results in the 1A and 1B group have been arranged in the form of a graph (Chart 1). In this chart the years following operation or treatment are indicated on the horizontal line and the percentage of cases alive and well on the vertical line. The broken line represents 93 cases of the early and border-line groups treated by hysterectomy, and indicates the dates at which recurrence or death took place, in successive cases, leaving 24 per cent alive and well at the end of the follow-up period. The solid line represents 114 cases treated with radium (without hysterectomy) and again indicates the rapidity with which the cases died off, up to the 18 per cent which were living at the end of the follow-up period.

TABLE XI.—DURATION OF LIFE IN CASES NOT "CURED"

	Cases	Months
HYSTERECTOMY ALONE		
Class 1A	18	21
Class 1B	4	27
Class 1C	9	13
Class 1D	..	..
RADIUM ALONE		
Class 1A	25	28
Class 1B	47	14
Class 1C	167	14
Class 1D	78	9
RADIUM, CAUTERY, AND X-RAY		
Class 1A	..	..
Class 1B	12	9
Class 1C	40	13
Class 1D	22	9

It is to be noted that the primary operative mortality in the hysterectomy cases (18 per cent) is more than counter-balanced before the end of the first year by the rapid dropping off of the radium cases and that thereafter the difference between the two lines is not very great, but, such as it is, is in favor of hysterectomy.

Table VIII gives the results of treatment in the 1C group in which the disease was believed to involve the broad ligaments at the time of operation or treatment. The results in the relatively small number of cases treated by hysterectomy remain the same, 13 per cent. Of the large number of cases treated with radium with or without palliative operation there was a falling off from 7 to 4 per cent.

It is in this group of advanced cases in which the falling off of the cases treated with radium is most conspicuous. On reflection, however, this is not surprising because this group includes the more advanced cases in which a cure by any method is relatively rare on account of the internal extension of the disease. With radium, destruction or control of the local disease in the uterus may be obtained even in advanced cases when it is used purely as a palliative measure. This period of temporary relief, before the further development of the internal manifestations of the disease, may apparently extend beyond 3 years and yet fail to reach 5 years in a small percentage of cases treated. From these figures it would appear that better results were obtained in the combination of radium and cauterization than

TABLE XII.—RECTOVAGINAL AND VESICO-VAGINAL FISTULÆ

	Cases	Fistulæ	Per cent
Spontaneous	688	8	1.1
After hysterectomy alone	74	4	5.5
After cautery alone	52	3	5.6
After radium alone	363	21	5.7
After hysterectomy and radium	70	4	5.6
After cautery and radium	91	7	7.0
Other methods	38	0	—
		47	

TABLE XIII.—LOCAL RESULTS OF TREATMENT

	Cases	"Cures"	Local Healing	Total
Hysterectomy alone	74	19	3	22
Hysterectomy and X-ray	2	0	1	1
Hysterectomy and radium	70	18	13	31
Radium alone	363	24	37	61
Radium and X-ray	20	4	6	10
Radium and palliative operation	95	17	14	31
Cautery alone	52	0	1	1
Other methods	12	1	0	1
	688	83	75	158

in the cases treated by radium alone. It is to be regretted that so few cases in this series were treated with X-ray that an estimate of the importance of the deep X-ray in combination with radium cannot be made.

Table IX shows the results of treatment in the 1D group of cases, these being advanced cases with fixation of the uterus or remote extension of the disease. In this series there were only 2 cases alive and well at the end of the 3 year period, and they remain alive and well at the end of the 5 year period. Both cases were treated with radium. As stated in the 1924 report, these cases were erroneously classed as hopeless, due in all probability to the difficulty in distinguishing by clinical examination alone the fixation of the uterus, which is due to cancer in the broad ligaments from a similar infiltration of a purely inflammatory character.

Table X, the results of treatment in cases with recurrence after hysterectomy, remains unchanged from the report of 1924. All of the cases there recorded are included in the 1928 report as still alive and well, and all of these cases were treated with radium.

In the report of 1924, statistics were published dealing with the life duration in the cases which failed of cure, together with the incidence of vesicovaginal and rectovaginal fistulæ, and the occurrence of "local healing" in the cases treated with radium.

These paragraphs are repeated from the 1924 report, as the figures are not changed in any way by the extension of the end-result period.

Table XI shows the duration of life in the cases not cured. It will be seen that no material difference exists as between the different methods of treatment.

In the early favorable group radium alone gave a slightly longer average of life, but in the less favorable cases this is not so apparent.

Four cases in the 1B group treated by hysterectomy averaged 27 months. These numbers, however, are so small that little reliance should be placed upon this isolated observation.

Rectovaginal and vesicovaginal fistulæ occur spontaneously in cases of cancer of the cervix. There were 8 such cases in the entire series of primary cases (Table XII).

The danger of fistula formation is apparently increased by any method of treatment, thus hysterectomy alone gave 5.5 per cent; cautery alone 5.6 per cent; radium alone 5.7 per cent; and cautery and radium 7 per cent.

It would appear that the danger of fistula formation should not weigh heavily in the choice of methods of treatment.

The value of radium as a palliative measure in the treatment of incurable cases is generally admitted (Table XIII). That life is materially prolonged by the use of radium is hard to prove.

Local healing of the disease in the cervix or vagina was noted, however, in 75 cases which failed of cure. This, of course, means relief from the offensive discharge and hæmorrhages which are characteristic of the advanced stages of the disease.

Table XIII indicates the methods of treatment which resulted in local cure. The small group of cases in which radium and X-ray were used is perhaps most striking. Of 20 cases, 4 were "cured" of their disease and 6 obtained local

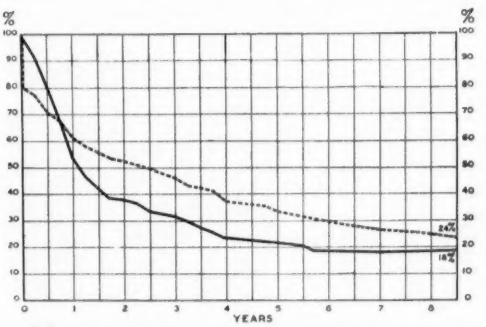

Chart 1. Cancer of the cervix, 207 cases. Broken line, 93 cases hysterectomy; solid line, 114 cases, radium without hysterectomy.

TABLE XIV.—ACTUAL NUMBER OF CASES AND PERCENTAGE OF TOTAL NUMBER "CURED" BY DIFFERENT METHODS OF TREATMENT

822 CASES—71 "CURES"

	"Cures"	Per cent
Hysterectomy alone	11	1.2
Hysterectomy with radium	16	1.9
Radium alone or with X-ray	22	2.6
Radium and palliative operation	22	2.6
Cautery alone	0	0
	—	-
	71	9

healing. Thus in 50 per cent of this small group the local lesion was destroyed.

Table XIV indicates the actual number of cases and the percentage of the total number which obtained successful results by the different methods of treatment. It will be seen that radium alone or with X-ray was responsible for 22 cases, or 2.6 per cent of the entire number; and radium and X-ray, with or without a palliative operation, gave 44 "cures," or 5.2 per cent of the entire number treated. This is to be taken merely as an indication of the absolute value of radium in treatment of this series of cases of cancer of the cervix. It is not in any way an indication of the relative value of radium as compared to hysterectomy.

In this second report of the end-results of treatment of cases of cancer of the cervix it was proposed to include an analysis of the methods of radiation treatment which were employed. The rapidly changing technique of radium therapy, however, appears to make this an unnecessary labor. Few of the clinics included in this investigation employ now the methods used in the period prior to 1920. It is believed that data of greater value will be obtained from the next series of cases of cancer of the cervix, to be collected by the Committee, which will include the years 1921–22–23.

SUMMARY

1. A series of 1,210 cases of cancer of the cervix derived from twenty-two different hospitals, recorded in a uniform manner to permit massing of the material, supported in every case in which a successful result is claimed by a pathological examination of the tissue; and carried to a minimum follow-up period of 5 years, and an actual average end-result of 8 years and 8 months, permits the following conclusions:

2. There were 681 primary cases of which 60, or 9 per cent, are alive and well, and 141 recurrent cases of which 11, or 8 per cent, are alive and well. The successful cases were all treated with radium or by hysterectomy. No cures were obtained by other methods.

3. In 237 cases of the early favorable and border-line groups, hysterectomy alone gave successful results in 1 case in 5. Hysterectomy with radium, either before or after, gave better than 1 in 4, but there was an 18 per cent operative mortality in all the cases of hysterectomy. Radium with or without the cautery gave successful results in about 1 case in 6, but without operative mortality. The best results of all, 1 successful case out of 3, were obtained in the cases in which both radium and cautery were employed. Under these conditions it may be said that the choice between operation and radium in the treatment of early and favorable cases of cancer of the cervix is an open one. It is to be borne in mind that the results of treatment by radium used with the technique of the present day, are not yet available but that it is generally believed that they will be better than the figures here presented.

4. In more advanced cases (1C and 1D) the "cures," either by radiation or by hysterectomy, were very few.

5. The duration of life in the unsuccessful early cases was somewhat greater after radium than with operation.

6. The formation of rectovaginal and vesicovaginal fistulæ occurred with nearly equal frequency with all methods of treatment.

7. Radium, with or without X-ray or palliative operation, was the most important agency in the destruction of local disease in cases which failed to obtain a "cure." The value of radium as a palliative measure in advanced cases is beyond dispute.

8. In the treatment of recurrent cases after hysterectomy, and in cases of cancer of the cervical stump, the use of radium is to be preferred to other methods.

9. A sufficiently large dosage of radium is necessary to obtain destruction of the local lesion. The treatment of cancer of the cervix with inadequate amounts of radium should not be encouraged.

10. It is to be regretted that a study of the pathological material of this series could not be made from the point of view of the pathological classification which was suggested by Broders and later by Martzloff—and elaborated by Schmitz and others.

11. "Late" recurrence, even as long as 7½ years following treatment, must be recognized as a possibility, though an unusual one, in cancer of the cervix.

12. Arguments for the use of radium in preference to hysterectomy in cases of cancer of the cervix are (1) the absence of operative mortality after radiation, and (2) the fact that in cases in which a "cure" is not obtained, the best known palliative method of treatment will have been employed. Diminution of discharge and hæmorrhage, even to the extent of local healing, occurs in many of these cases, even though the patient is not cured.

REPORT No. III.—CANCER OF THE BREAST

The third report of this Committee deals with the treatment of cancer of the breast. Abstract cards were prepared and distributed by the Committee[1] and records, classified and recorded in a uniform manner, were obtained from the clinics in the various cities which were represented in the investigation. The cases selected for study were those which entered the wards of the hospitals during the calendar years 1918, 1919, and 1920. Each clinic provided an abstract record of every case of cancer of the breast which entered the hospital wards during that period, whether treated by operation, with radium, or by any other method.

From hospitals in Boston, New York, Toronto, Baltimore, and Chicago, 774 records were collected, as indicated in Table I. The problem before the committee was to collect accurate data in regard to the end-results in cases of cancer of the breast whether treated by operation, by X-ray, or by other methods or combinations of these methods. In order to make possible a fair comparison of the results of all methods of treatment, such data as have been acknowledged by the surgical world to be necessary in reporting the end-results of operative treatment of cancer in its various locations, were required in every case (i.e. pathological confirmation of the diagnosis of cancer—and a minimum follow-up of 5 years).

It was necessary also to obtain a classification of cases with regard to the extent of the disease present at the time of admission to the hospital, in order that the results in early and favorable cases should not be compared directly with those in advanced cases subjected only to palliative treatment. Such a classification of cases based upon the physical examination of the patient at the time of admission and corrected when possible by subsequent operative findings and pathological data has been procured.

The standard surgical report of end-results in cancer cases demands microscopic pathological evidence of the presence of cancer. In operative cases this is readily obtained. In cases suitable only for radiation therapy this is not always deemed to be a safe procedure, but the diagnosis is nevertheless frequently confirmed by the subsequent progress of the disease. This is true also in respect to cases of recurrence after operation, in cases in which the diagnosis depends upon the clinical examination alone. Should such cases occur in the statistics as successful results the facts are noted. Nothing short of a 5 year end-result is accepted and cases which did not have sufficient data for classification have been rejected from the investigation.

The word "cure" has been eliminated from this report in deference to criticism of its use in previous reports in connection with cancer of the cervix, although the word was used only as a convenient manner of expressing the fact that the patient was alive and well or had died without recurrence at a date later than the designated period of 5 years. The possibility of "late" recurrence, especially in cases of cancer of the breast, is so well recognized that a follow-up period of even 20 years would still make it necessary to avoid the unqualified statement that a case was actually cured of the disease.

Radical operation for cancer of the breast at the present day permits of a number of different incisions but is commonly understood to demand the removal in one piece of the following structures: The breast, with all the skin over the breast, the pectoralis major and minor muscles, the axillary contents with the exception of the vein, artery, and brachial plexus, and the deep fascia from clavicle to epigastrium and from sternum to latissimus. In certain clinics, both in Chicago and New York, a modification of this radical operation is practised in which the pectoralis minor is not removed. A comparison of the results of this procedure with those of the standard radical operation is of considerable interest.

From the records available in this investigation, an accurate statement of the details of X-ray treatment is not possible. In the years 1918, 1919, and 1920 treatments with X-ray were given

[1]The members of the Committee (January, 1929) are as follows: A. C. Broders, Rochester, Minnesota; C. F. Burnam, Baltimore; G. W. Crile, Cleveland; B. C. Crowell, Chicago; William Duane, Boston; Edwin C. Ernst, St. Louis; J. M. T. Finney, Baltimore; B. J. Jee, New York; Frank Lynch, San Francisco; R. T. Miller, Jr., Baltimore; H. K. Pancoast, Philadelphia; H. G. Wells, Chicago; F. C. Wood, New York City; and R. B. Greenough, Boston, chairman.

TABLE I.—DISTRIBUTION OF SEVEN HUNDRED SEVENTY-FOUR RECORDS COLLECTED, 1918, 1919, 1920.

	Cases
1. Massachusetts General Hospital	177
2. Collis P. Huntington Memorial, Boston	184
3. Free Hospital for Women, Boston	24
4. Mount Sinai Hospital, New York	32
5. Toronto General Hospital	29
6. Roosevelt Hospital, New York	79
7. Johns Hopkins and St. Agnes Hospitals, Baltimore	81
8. Peter Bent Brigham Hospital, Boston	68
9. Presbyterian Hospital, Chicago	100
	774

TABLE II.—SUMMARY ALL (774) CARDS 1918, 1919, 1920

Rejected	
Inconclusive data	40
Untraced	52
No treatment	35
Alive and well, no pathological report	2
Not cancer	13
Duplication	23
Not of 1918–1919–1920	9
Insufficient data	64
Total rejected	238
Or	
Massachusetts General Hospital	46
Collis P. Huntington Memorial, Boston	46
Free Hospital for Women, Boston	7
Mount Sinai, New York	9
Toronto General Hospital	16
Roosevelt Hospital, New York	18
Johns Hopkins and St. Agnes Hospitals, Baltimore	32
Peter Bent Brigham Hospital, Boston	19
Presbyterian Hospital, Chicago	45
	238
Accepted	536
	774

in most of these hospitals with what would now be considered low-voltage apparatus. In other hospitals, however, more penetrating radiation was available and was employed. It is to be regretted that accurate data on this subject could not be obtained for a sufficient number of cases to justify conclusions. It may be said, however, that in many hospitals even at the present day low-voltage treatments in cases of cancer of the breast are preferred as a routine, and high-voltage apparatus is used only in cases of definite involvement of the spine, mediastinum, pleura, or lung. Radium was used, usually by insertion in superficial areas of recurrence, in only a very small number of cases in this series.

It was necessary to reject 238 records of the total of 774 for the reasons recorded in Table II. Forty were inconclusive as to the end-result; 52 were entirely untraced; 35 received no treatment; 2 cases were alive and well over 5 years, but had no pathological report to substantiate the diagnosis of cancer; 13 proved not to be cancer; 23 were duplicates; 9 entered the hospital before or after the period under investigation; and 64 had insufficient data to permit classification. The rejected cards came from the different hospitals as indicated in Table II. After the elimination of these cases, 536 records were available for study.

TABLE III.—CLASSIFICATION AND PERCENTAGE OF SUCCESSFUL CASES—FIVE YEAR END-RESULTS, 1918, 1919, 1920.

Primary cases	Cases	Alive and well	Per cent
1 A glands not involved	80	47	59
1 B/A	3	1	33
1 C/A	20	11	55
	103	59	57
1 B glands doubtful	9	3	33
1 C/B	1	0	0
	10	3	30
1 C glands involved	195	21	11
1 A/C	55	18	33
1 B/C	5	1	20
	255	40	16
Total operable cases	368	102	28
1 D supraclavicular glands	23	0	0
1 E remote metastases	14	0	0
1 F opposite breast involved	3	0	0
	40	0	0
Total primary cases	408	102	25
Recurrent cases			
2 recurrent after radical operation	76	2	3
3 recurrent after incomplete operation	52	1	5
Total recurrent	128	3	3
Total cases	536	105	20

TABLE IV.—FIVE YEAR END-RESULTS IN FOUR HUNDRED EIGHT PRIMARY CASES, 1918, 1919, 1920

	Cases	Alive and well	Per cent
Cases	408	102	25
Radical operation without X-ray	220	72	33
Radical, both pectorals	178	61	34
Radical, minor not removed	42	11	26
Radical operation with pre-operative X-ray	4	3	75
Radical operation with postoperative X-ray	90	20	22
Radical operation with pre- and post-operative X-ray	14	3	21
Radical operation with X-ray (pro)	108	26	24
Radical operation with X-ray for recurrence	7	0	
All radical operations with X-ray	115	26	23
All radical operations	335	98	29
Incomplete operation alone	20	3	15
Incomplete operation with X-ray	21	1	5
Incomplete operation with or without X-ray	41	4	10
No operation—X-ray only	32	0	0

TABLE V.—FIVE YEAR END-RESULTS OF TREATMENT IN ONE HUNDRED TWENTY-EIGHT CASES RECURRENT AFTER OPERATION, 1918, 1919, 1920.

After radical operation	76
After incomplete operation	52
Total	128

	Died	Alive with recurrence	Alive and well
Radical operation without X-ray	6	1	0
Radical operation with X-ray	4	0	0
Excision without X-ray	6	0	0
Excision with X-ray	10	4	1
X-ray alone	87	2	2
No treatment	5	0	0
	118	7	3

TABLE VI.—LIFE DURATION IN RECURRENT CASES TREATED WITH AND WITHOUT PROPHYLACTIC X-RAY, 1918, 1919, 1920.

	Cases	Average life duration in months
Radical operation with X-ray	85	30
Radical operation alone	130	30
Incomplete operation with X-ray	14	20
Incomplete operation without X-ray	11	32
X-ray, no operation	17	33

One hundred twenty-eight of these were recurrent cases and 408 were primary cases.

Table III gives the classification and percentage of successful cases in the different groups of which we have distinguished six degrees of development of the disease. 1A indicates disease restricted to its point of origin in the breast with the axillary glands not involved, either on clinical examination or by pathological examination after operation. 1B/A indicates that the axillary glands on clinical examination were doubtful but were proved not to be involved by pathological examination. 1C/A indicates that clinically the glands were enlarged but on pathological examination they were not malignant. 1B indicates the cases in which the condition of the axillary glands is in doubt, but 1C/B would indicate that the glands were felt to be enlarged but that pathological examination was not recorded. These two groups are, of course, of little value for study. In the 1C group the axillary glands are enlarged and proved microscopically to be involved with cancer. 1A/C signifies that they were not clinically enlarged but proved to be malignant only on pathological examination.

It is of interest to note the degree of accuracy with which the clinical examination and the pathological reports agree in regard to the involvement of the axillary glands. In 215 cases the glands were recorded as enlarged; and in 195 of these cases (90 per cent) they proved to be cancerous on pathological examination. In 135 cases axillary glands were recorded as not enlarged, but in 55 of these (40 per cent) pathological examination showed the presence of cancer in the glands after operation. These facts amply justify the usual assumption that the axillary glands should be regarded as potentially malignant in every case of cancer of the breast.

These three groups (1A, 1B, 1C) make up the operable cases, 368, and yield 5 year successful results[1] in 28 per cent. The more advanced cases are included in the next three groups; 1D, supraclavicular glands enlarged; 1E, remote metastases as chest, spine, liver, etc.; and 1F, disease of the opposite breast. This gives a total of 408 primary cases with a 5 year successful result of 25 per cent. The recurrent cases are divided between 76 cases, recurrent after radical operation, and 52 cases recurrent after incomplete operation. In all of the recurrent cases only 3 per cent gave satisfactory results at the end of the 5 years.

Table IV records the results of different methods of treatment in the 408 primary cases. In this table contrast is made between the cases of radical operation treated with, and those without, prophylactic X-ray. Two hundred twenty cases had radical operation without prophylactic X-ray with 33 per cent successful. One hundred fifteen had radical operation with prophylactic X-ray, either pre-operative, postoperative, or both. These cases gave only 23 per cent of success. Charts 1 and 2 are graphs designed to show the rapidity with which these cases died or developed recurrence after operation. It is to be noted that there is little difference between the curve of the cases which had radical operation alone and that of the cases in which radical operation was supplemented by prophylactic X-ray treatment.

Incomplete operations with or without X-ray gave only 10 per cent successful results. Cases in which the standard radical operation was done with removal of both pectorals gave 34 per cent success and those in which the minor was not removed gave only 26 per cent. In only 4 cases was pre-operative X-ray alone given and of this number the end-result was successful in 3, or 75 per cent. The numbers, however, are very small: 90

[1]Of the 105 cases recorded as successful 98 are alive and well and 7 died of disease other than cancer and without recurrence over 5 years after treatment. Of the 431 unsuccessful cases 401 are dead and 30 are recorded as alive with recurrence. There were 11 hospital deaths after operation in the whole series—approximately 2 per cent.

TABLE VII.—LOCAL RECURRENCE IN FIELD OF OPERATION IN RECURRENT CASES, AS AFFECTED BY PROPHYLACTIC X-RAY, 1918, 1919, 1920.

	Cases	Local recurrence	Per cent
Radical operation without X-ray	54	24	44
Radical operation with X-ray	59	29	49

cases were given post-operative X-ray with 22 per cent success, and 14 were given both pre-operative and postoperative X-ray with 21 per cent success. Thirty-two cases were not operated upon but were treated with X-ray alone and none of these are living. These figures fail to indicate that the use of prophylactic X-ray increases in any way the number of cases of cancer of the breast which are free from recurrence 5 years after operation.

Table V shows the different methods of treatment employed and the results in cases entering the hospital with recurrence after operation. There were 128 of these cases, 76 with recurrence after radical operation and 52 with recurrence after an incomplete operation. Only 3 of these cases are alive and well at the end of the 5 year period, 2 treated by X-ray alone, and 1 by excision and X-ray. In the 2 cases treated by X-ray alone the diagnosis of recurrence was a clinical diagnosis only and was not supported by pathological examination of the tissue. In the third case the pathological examination of the excised tissue is not recorded. Of this series 7 other cases are still alive, at the end of the 5 year period, but with clinical evidence of disease. The remaining 118 cases are dead.

Tables VI and VII deal with the results of prophylactic X-ray treatment as regards life duration

TABLE VIII.—LOCAL RECURRENCE IN SEVENTEEN RECURRENT CASES, 1918, 1919, 1920.

	Cases	Average duration of life, months
Without X-ray	3	31
With X-ray	13	38
Inconclusive, omitted	1	
Excised and X-ray—alive and well	1	80
Excised and X-ray, alive—with recurrence	1	88
Excised, no X-ray, alive—with recurrence	1	108

and local recurrence in the field of operation, in the unsuccessful cases of radical operation. One hundred thirty cases of radical operation alone, which failed of cure, lived an average of 30 months; 85 cases of radical operation with prophylactic X-ray treatment lived also an average of 30 months; 11 cases of incomplete operation without X-ray averaged 32 months, while 14 that had X-ray lived only 20 months, and 17 cases treated by X-ray alone averaged 33 months of life. It is thus seen that prophylactic X-ray does not add to the life duration in cases of radical operation which fail of cure.

It has been maintained that prophylactic X-ray tends to diminish the frequency of local recurrence within the field of operation. Table VII gives data on this subject, and although precise information as to the location of recurrence was not available in every case there are sufficient data to justify conclusions. In 54 cases of radical operation without X-ray 24, or 44 per cent, showed local recurrence in the field of operation, while in 59 cases of radical operation which did have prophylactic X-ray 29, or 49 per cent, showed local recurrence. In this respect also

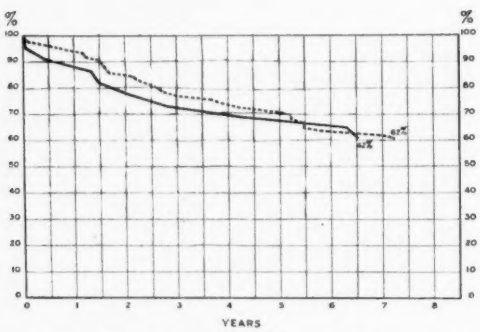

Chart 1. Ninety-three cases. Class A, Axillary glands not involved. Broken line indicates 69 radical operations without X-ray. Solid line 24 radical operations with prophylactic X-ray.

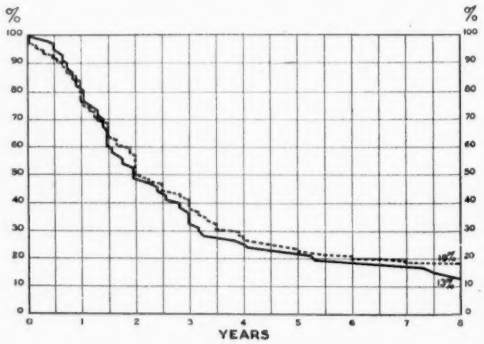

Chart 2. Two hundred nineteen cases. Class C, Axillary glands involved. Broken line indicates 149 radical operations without X-ray. Solid line indicates 70 radical operations with prophylactic X-ray.

TABLE IX.—AXILLARY RECURRENCE IN TWENTY-NINE RECURRENT CASES, 1918, 1919, 1920.

	Cases	Time interval in months
Class 2C—Local recurrence with axillary involvement (after radical operation):		
X-ray alone (recurrence not proved by pathologist) alive and well	1	86
X-ray (2 of these excision also) alive with recurrence	3	54 to 94
X-ray alone—died	9	4 to 66
Total Class 2C	13	
Class 3C—Local recurrence with axillary involvement (after incomplete operation):		
X-ray alone (recurrence not proved by pathologist) alive and well	1	89
Excision—no X-ray—died	5	5 to 79
X-ray alone—died	4	6 to 37
Operation and X-ray—died	3	8 to 69
Inconclusive—omitted	3	
Total Class 3C	16	
Summary 2C and 3C—Local recurrence in axilla	29	
Without X-ray	5	24
With X-ray	21	35
Inconclusive—omitted	3	
With X-ray(no excision,neither proved) alive and well	2	86 to 89
With X-ray, alive with recurrence	3	54 to 89

there appears to be no material advantage to the patient in the employment of prophylactic X-ray as a supplement to radical operation.

An opportunity is provided by these records to estimate the value of the treatment by X-ray of definite recurrence of cancer of the breast after operation. Tables VIII, IX, and X show the results in these cases. As with the primary cases, they are classified according to the extent of the disease at entrance. Table VIII shows the results of treatment in 17 cases of the group in which recurrence is present only in the field of operation without evidence of more remote extension. Three without X-ray treatment lived an average of 31 months, 13 that had X-ray lived 38 months. One case in which the local recurrence was excised and X-ray treatment given is alive and well, now 80 months after entrance.

Table IX deals with cases of axillary recurrence —29 cases. Five cases without X-ray treatment averaged 24 months' duration, 21 cases with X-ray treatment averaged 35 months' duration. Two of the X-ray patients are alive and well at 86 and 89 months. (In neither case was the clinical diagnosis of recurrence proved by pathological examination.)

Table X gives the results in the more advanced groups with supraclavicular recurrence (2D and 3D); with remote metastases in spine, lung, liver, etc., (2E and 3E); with involvement of the opposite breast (2F and 3F); and in the chest wall (2G and 3G). All of these cases are dead. Those of supraclavicular recurrence averaged 15 months' duration on X-ray treatment; remote deep metastases averaged 14 months and involvement of the other breast 13 months. The longest duration of any of the Table X advanced cases was 56 months, a case of double amputation for cancer of the second breast followed by X-ray. From these data on the treatment of recurrence we may conclude that X-ray prolongs life, but that very few cures by X-ray alone are to be expected.

TABLE X.—RESULTS IN MORE ADVANCED GROUP, 1918, 1919, 1920.

	Cases	Time interval in months
Class 2D-3D—Supraclavicular involvement:		
Excision alone—died	1	5
Excision and X-ray—died	4	3 to 54
No treatment—died	3	0 to 9
X-ray alone—died	35	1 to 48
Total Class 2D-3D	43	
Class 2E-3E—Remote metastases:		
No treatment—died	3	1 to 3
X-ray—died	16	1 to 44
Inconclusive—omitted	1	
Total Class 2E-3E	20	
Class 2F-3F—Opposite breast involved:		
Operation alone—died	4	1 to 48
No treatment—died	1	24
Operation and X-ray—died	3	1 to 56
X-ray alone—died	6	2 to 38
Inconclusive—omitted	1	
Total Class 2F-3F	15	
Class 2G-3G—Recurrence in chest wall:		
Excision and X-ray—died	2	14 to 27
Total Class 2G-3G	2	

SUMMARY AND CONCLUSIONS

1. The study of 536 cases of cancer of the breast from 9 different hospitals in 1918, 1919, and 1920, recorded and classified in a uniform manner on a minimum 5 year end-result basis and supported by pathological evidence of the diagnosis of cancer, yields the following results:

2. Twenty per cent of all cases entering the hospital are alive and well at the end of 5 years after treatment.

3. Twenty-five per cent of all primary cases are alive and well at the end of 5 years.

4. Twenty-eight per cent of the "operable" cases are alive and well at the end of 5 years.

5. The early favorable cases without axillary involvement give 57 per cent of successful results.

6. The more advanced cases with axillary glands involved gave only 16 per cent of successful results.

7. The "inoperable" cases, with remote metastases, are all dead.

8. Of the cases entering the hospital with recurrence after operation only 3 per cent are alive and well.

9. No successful results were obtained without operative treatment.

10. In primary cases the best results (29 per cent) were obtained by the standard radical operation, with or without prophylactic X-ray.[1]

11. In primary cases incomplete operation with or without X-ray gave only 10 per cent success.

12. In primary cases X-ray alone gave no success.

13. The results of the standard radical operation with removal of both pectoral muscles (34 per cent) were superior to those in which the pectoralis minor was not removed (26 per cent).

14. The addition of pre-operative or post-operative prophylactic X-ray treatment to the radical operation gave no greater proportion of 5 year successful results.

15. Prophylactic X-ray did not prolong life in the unsuccessful cases.

16. Prophylactic X-ray did not diminish the incidence of local recurrence in the field of operation in unsuccessful cases.

17. There is no evidence in this series of cases to support the contention that prophylactic X-ray is of value as a supplement to operation in cases of cancer of the breast.

18. The value of X-ray in the treatment of recurrence after operation is established.

19. Three patients are alive and well over 5 years as a result of X-ray treatment of recurrence. In one of these excision of the recurrence was performed, in addition to X-ray treatment, but in no case was the recurrence proved by pathological examination.

20. Patients with recurrence treated by X-ray lived longer than those in which X-ray treatment was *not* given.

21. The most marked benefit from X-ray treatment was obtained in the cases of local recurrence in the field of operation or in the axillary region.

22. Advanced cases with remote metastases were little benefited by X-ray treatment.

[1]Exact data as to dosage of X-ray employed in these cases were not always available. In general low voltage treatment was in use at this time. (See text.)

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

FRANKLIN H. MARTIN, Chicago, *President* MERRITTE W. IRELAND, Washington, *President-Elect*

CHICAGO EXECUTIVE COMMITTEE

HERMAN L. KRETSCHMER, *Chairman* LOYAL DAVIS, *Secretary*

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ALLEN B. KANAVEL
PHILIP H. KREUSCHER
EDWIN MCGINNIS
DALLAS B. PHEMISTER
ALFRED A. STRAUSS

PRELIMINARY CLINICAL PROGRAM FOR THE CLINICAL CONGRESS

A PRELIMINARY program of the clinics and demonstrations to be given in the hospitals and medical schools of Chicago during the nineteenth annual Clinical Congress of the American College of Surgeons which opens on Monday, October 14th, continuing for five days up to and including Friday, October 18th, will be found in the following pages. The clinical program as here published is merely an outline of what the clinicians of Chicago expect to present at this year's session. The hospital schedules are to be revised and expanded during the weeks preceding the Congress to present more completely the details of the clinical work to be demonstrated. Chicago surgeons are keenly interested to provide a complete showing of the clinical surgical activities of this great medical center. It will be noted that the program provides for operative clinics and demonstrations beginning at 2 o'clock on Monday and continuing during the mornings and afternoons of each of the following four days.

Since the last session of the Clinical Congress in Chicago, in 1923, a number of new hospitals have been built, some of the older institutions have been remodeled and enlarged, and in keeping with the growth of the city its clinical facilities have been largely increased.

It is quite evident at this time that Chicago's popularity as a clinical center will be maintained at this year's Congress. There has been an unusually heavy advance registration on the part of those who are planning to be present, and in addition a wide-spread interest in the plans for this year's meeting is apparent.

The real program of the Congress will be issued daily in the form of bulletins to be posted at headquarters each afternoon, thus providing a complete and accurate schedule of the clinics and demonstrations to be given at each of the hospitals on the following day. Printed bulletins will be distributed each morning.

Special attention is to be devoted to the demonstration of modern methods in the treatment of fractures. At the Cook County Hospital a special fracture clinic will be conducted each morning and afternoon, and at many of the larger hospitals plans are being made for a complete showing of the methods and end-results in this special field which forms so large a part of the surgical work in this great city.

An added clinical feature of importance at this year's session will be provided by a series of clinics to be given by outstanding surgeons of the American continent on Tuesday and Wednesday afternoons beginning at 2 o'clock in the grand ballroom of the Stevens Hotel. Among those who will give clinics are the following: George W. Crile, Cleveland; John B. Deaver, Philadelphia; John M. T. Finney, Baltimore; Charles H. Mayo, Rochester. A symposium on pernicious anemia will be presented by Charles A. Elliott, Chicago; George H. Whipple, Rochester, New York; C. C. Sturgis, Ann Arbor, Michigan; and William P. Murphy, Boston.

Of especial interest to those whose practice is limited to surgery of the eye, ear, nose, and throat are the plans of the sub-committee in charge of that section of the program. As shown in the preliminary program, the ophthalmologists

and otolaryngologists of Chicago are planning a highly interesting clinical program of broad scope. In addition, two evening scientific meetings are planned, one on Tuesday evening at which a series of papers dealing with surgery of the eye will be presented, and a second session on Wednesday evening when the papers will be devoted to various aspects of otolaryngological surgery.

An important feature of this year's Congress will be the showing of several surgical films that have been produced under the supervision and approved by the Board on Medical Motion Picture Films. Several such films will be given their premier showing in Chicago. Also, it is planned to exhibit certain other surgical films.

A conference on traumatic surgery is planned for Friday with sessions both morning and afternoon. The chairman of the Committee on Traumatic Surgery will report on the work of the Committee in recent years and outline future activities in this highly important department of the work of the College. The program for this conference includes an open forum for the discussion of the various phases of the subject and a formal presentation of papers by outstanding men. Leaders in industry, education, and labor, together with representatives of indemnity companies, surgeons, and hospital administrators, will contribute to the discussion. A detailed program for this conference is in preparation and will be published at an early date.

General headquarters for the Congress will be established at the Stevens Hotel, located on Michigan Avenue between Seventh and Eighth Streets, where the grand ballroom, three smaller ballrooms, and many other large rooms have been reserved for the exclusive use of the Congress for the scientific meetings, hospital conferences, registration and ticket bureaus, bulletin boards, scientific exhibits, executive offices, etc. All of the evening meetings are to be held in the grand ballroom, the same room being used for the hospital conference on Monday, the annual meeting on Thursday afternoon, and the conference on traumatic surgery on Friday.

EVENING SESSIONS

Programs for a series of five evening meetings are being prepared by the Executive Committee of the Clinical Congress. At the presidential meeting on Monday evening, in the grand ballroom of the Stevens Hotel, the President-elect, Major-General Merritte W. Ireland, surgeon-general of the army, is to be inaugurated and will deliver the annual address. Dr. D. P. D. Wilkie, professor of surgery in the University of Edinburgh, will deliver the Murphy oration in surgery on the same evening. Scientific meetings are planned for Tuesday, Wednesday, and Thursday evenings at which eminent surgeons of the United States and Canada and distinguished visitors from abroad will present papers dealing with surgical subjects of present-day interest. The annual convocation of the College, at which the 1929 class of candidates for fellowship will be received, is to be held on Friday evening in the grand ballroom of the Stevens Hotel.

ANNUAL MEETING—CANCER SYMPOSIUM

The annual meeting of the Fellows of the College will be held at 2 o'clock Thursday afternoon in the grand ballroom, at which time the reports of officers and committees will be presented and officers elected for the ensuing year. Immediately following the annual meeting there will be presented a symposium on the treatment of malignant diseases with radium and X-ray, which will include contributions by distinguished surgeons and research workers dealing with many aspects of this problem.

ANNUAL HOSPITAL CONFERENCE

The keynote of this year's Hospital Conference will be "the care of the patient." In discussing the everyday problems of the boards of trustees, medical staffs, and hospital executives, with a view to promoting better understanding and closer relations among the several groups that have to do with the care of the patient, this will be the predominant idea.

The Hospital Conference opens at 9:30 on Monday morning, October 14th, in the grand ballroom of the Stevens Hotel at which time the President of the College, Dr. Franklin H. Martin, will present the annual report for 1929 and the official list of approved hospitals. Dr. Arnold H. Kegel, commissioner of health for Chicago, will deliver the address of welcome which will take the form of an appeal for full co-operation between the medical profession, hospital executives, and health departments. Dr. Malcolm T. MacEachern, associate director of the College in charge of hospital activities, will discuss hospital problems of the present and future.

The feature of Monday afternoon's program will be the practical demonstration of a model staff conference by one of the local hospital groups, together with a discussion of the entire subject of staff conferences.

A symposium on the prevention of infection and a round table conference on administrative

problems, admission of patients, the clinical laboratory, the social worker, etc., are important features of the second day's program and will include a practical demonstration of an administrative conference.

On Wednesday morning there will be a joint session with the Association of Record Librarians given over to a symposium dealing with the efficiency of case records.

The complete program for the hospital conference includes sessions both morning and afternoon for the four days, Monday to Thursday inclusive, Friday being left free for visiting Chicago hospitals and sightseeing. The Hospital Conference is planned to interest not only surgeons but also hospital trustees, executives and personnel generally, and an invitation is extended to all persons who are interested in hospital activities to attend this year's Conference. Those who plan to attend are invited to avail themselves of the other activities of the Congress, and especially to attend the presidential meeting on Monday evening and the convocation on Friday evening.

REDUCED RAILWAY FARES

The railways of the United States and Canada have authorized reduced fares on account of the Chicago session of the Clinical Congress so that the total fare for the round trip will be one and one-half the ordinary first-class one-way fare. To take advantage of the reduced rates it is necessary to pay the full one-way fare to Chicago, procuring from the ticket agent when purchasing ticket, a "convention certificate" which certificate is to be deposited at headquarters for the visé of a special agent of the railways. Upon presentation of a viséd certificate to the ticket agent in Chicago not later than October 30th a ticket for the return journey by the same route as traveled to Chicago may be purchased at one-half the one-way fare.

In the eastern, central, and southern states and eastern provinces of Canada, tickets may be purchased between October 10th and 18th; in southwestern and western states between October 9th and 17th, and in the far western states and western provinces of Canada between October 6th and 14th. The return journey from Chicago must be begun not later than October 30th.

The reduction in fares does not apply to Pullman fares, nor to excess fares charged for passage on certain trains. Local railroad ticket agents will supply detailed information with regard to dates of sale, rates, routes, etc. Stop-overs on both the going and return journeys may be had within certain limits.

Full fare must be paid from starting point to Chicago, and it is essential that a "convention certificate" be obtained from the agent from whom the ticket is purchased. These certificates are to be signed by the general manager of the Clinical Congress and viséd by a special railroad agent in Chicago during the meeting. No reduction in railroad fares can be secured except in compliance with the regulations outlined and within the dates specified. It is important to note that the return trip must be made by the same route as that used to Chicago and that the certificate must be presented during the meeting and return ticket purchased and used not later than October 30th.

It will be noted that the arrangement outlined above, extending the return limit to October 30th, allows for an additional twelve days following the close of the Clinical Congress that may be devoted to visiting other clinical centers in the middle west.

An exception to the above arrangement is to be noted in the case of persons traveling from points in the Pacific and certain western states and British Columbia, who will be able to purchase round trip summer excursion tickets which will be on sale up to and including September 30th with a final return limit of October 31st. The summer excursion fare is somewhat lower than the convention fare mentioned above, but is available only in certain of the far western states and British Columbia. Tickets sold at summer excursion rates permit traveling to Chicago via one direct route and returning via another direct route, with liberal stop-over privileges.

LIMITED ATTENDANCE

Attendance at the Chicago session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories in the hospitals and medical schools to determine their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics, and insures against overcrowding, as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given. Clinic tickets will be distributed each morning and may be reserved late on the previous day.

REGISTRATION FEE

A registration fee of $5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card at headquarters. This card, which is non-transferable, must be presented to secure clinic tickets and admission to the evening meetings.

CHICAGO HOTELS AND THEIR RATES

In recent years a number of fine large hotels have been built in Chicago, among which is the Stevens with its 3000 guest rooms. Ample first-class hotel facilities are available, many of the hotels being located within short walking distance of the headquarters hotel.

	Minimum Rates with Bath	
	Single Room	Double Room
Auditorium, Michigan Ave. and Congress St.	$3.50	$5.00
Belmont, 3100 Sheridan Road	4.00	5.00
Bismarck, 175 W. Randolph St	3.50	5.00
Blackstone, Michigan Ave. and East 7th St.	5.00	10.00
Chicago Beach, Hyde Park Blvd. at the Lake	5.00	5.00
Congress, Michigan Ave. and Congress St.	4.00	6.00
Drake, Michigan Ave. and Walton Place	5.00	6.00
Edgewater Beach, 5349 Sheridan Road	4.00	6.00
Fort Dearborn, Van Buren and LaSalle Sts.	1.95	3.00
Great Northern, Jackson Blvd. and Dearborn	3.50	4.50
Knickerbocker, Walton Place and Michigan	3.00	5.00
Lake Shore Drive, 181 Lake Shore Drive	5.00	7.00
LaSalle, LaSalle and Madison Sts	3.00	4.50
Morrison, Clark and Madison Sts	2.50	5.00
Palmer, Monroe and State Sts	4.00	7.00
Parkway, 211 Lincoln Park West	3.00	5.00
Pearson, St. Clair and Pearson Sts	3.50	5.00
Sherman, Clark and Randolph Sts	3.00	4.00
Stevens, Michigan Ave. and 7th St	3.50	6.00
Webster, Lincoln Park West at Webster Ave.	3.00	5.00

PRELIMINARY CLINICAL PROGRAM

GENERAL SURGERY, GYNECOLOGY, OBSTETRICS, UROLOGY, ORTHOPEDICS

COOK COUNTY HOSPITAL

Monday

F. H. FALLS—2. Operative obstetrics.
SUMNER L. KOCH—2. Surgery of the hand; general surgery.

Tuesday

R. W. MCNEALY—9. Blood vessel surgery.
A. E. KANTER—9. Operative gynecology.
W. R. CUBBINS—9. Ward walk in fracture ward.
E. L. CORNELL—9. Complications of pregnancy and labor.
H. JACKSON—10. Injuries of the brain.
J. R. HARGER—10. Acute osteomyelitis.
E. M. MILLER—10. Toxic thyroid disease in children; purpura hæmorrhagica.
D. C. STRAUSS—11. Surgery of the thyroid.
KELLOGG SPEED—2. Tumors of bone; fractures of carpal bones.
GEORGE DE TARNOWSKY—2. Rupture of the bladder.
E. J. LEWIS—2. Sliding hernia.
J. P. GREENHILL—2. Operative gynecology.

Wednesday

HARRY CULVER—9. Genito-urinary surgery.
W. R. CUBBINS—9. Round table discussion on fractures.
H. SCHMITZ—9. Inflammation of the pelvic organs; carcinoma of the pelvic organs.
F. J. JIRKA—10. General surgery.
P. H. KREUSCHER—10. Osteomyelitis; congenital deformities; arthroplasty of hip; arthroplasty of elbow.
J. R. BUCHBINDER—2. Surgery of the thyroid.
F. H. FALLS—2. Operative obstetrics.
J. P. FITZGERALD—2. Obstetrical complications.
H. C. ROLNICK—2. Intravenous anæsthesia in urologic surgery.
SUMNER L. KOCH—2. Surgery of the hand; general surgery.

Thursday

R. W. MCNEALY—9. Blood vessel surgery.
J. R. HARGER—10. Acute osteomyelitis.
E. M. MILLER—10. Fractures about the elbow in children.
H. JACKSON—10. Operations under spinal anæsthesia.
KARL MEYER—10. Gastric surgery.
W. R. CUBBINS—2. Fractures of femur.
D. S. HILLIS—2. Obstetrics.
A. F. LASH—2. Treatment of puerperal infection.

Friday

G. L. APFELBACH—9. Surgical complications of diabetes.
A. E. KANTER—9. Operative gynecology.
E. L. CORNELL—9. Complications of pregnancy and labor.
F. A. DYAS—10. Thyroid disease; carcinoma of the breast.
V. C. DAVID—10. Carcinoma of large bowel.
GEORGE DE TARNOWSKY—2. General surgery.

GARFIELD PARK HOSPITAL

Wednesday

C. C. ROGERS, H. L. BAKER, J. M. BERGER, F. L. BROWN, G. G. FOUSER, J. R. HARGER, L. F. MACDIARMID, and F. D. MOORE—9. General surgery.
VINCENT J. O'CONOR—9. Genito-urinary clinic: Medical aspects presented by DR. THEODORE TEIKEN, pathology by DR. P. SCHMITT, roentgenology by DR. DAHLE.

PASSAVANT MEMORIAL HOSPITAL—NORTHWESTERN UNIVERSITY MEDICAL SCHOOL

Monday

CHARLES A. ELLIOTT and associates—2. Symposium on diseases of the liver and bile passages: Cirrhosis of the liver by Paul Starr; surgery in jaundiced patients by H. M. Richter; the gall-bladder hormone by A. C. Ivy; the spinal cord pathway of afferent impulses from the gall bladder by J. T. Hart and R. C. Crain.

Tuesday

H. M. RICHTER—9. Cholecystectomy, cholelithiasis.
LOYAL DAVIS—9. Trigeminal neuralgia.
S. W. RANSON, L. J. POLLOCK, and LOYAL DAVIS—2. Symposium on the diagnosis and surgical treatment of diseases affecting muscle function.

Wednesday

ALLEN B. KANAVEL—9. Thyroid surgery.
J. R. BUCHBINDER—9. Thyroid surgery.
JAMES G. CARR, CHARLES A. ELLIOTT, H. M. RICHTER, and ALLEN B. KANAVEL—2. Symposium on diseases of the thyroid gland.

Thursday

H. M. RICHTER—9. Thyroid surgery.
LOYAL DAVIS—9. Brain tumor.
ALLEN B. KANAVEL, SUMNER L. KOCH, MICHAEL L. MASON, and C. G. SHEARON—2. Symposium on surgery of the hand.

Friday

ALLEN B. KANAVEL—9. Dupuytren's contraction.
SUMNER L. KOCH and MICHAEL L. MASON—9. Tendon transplantation.

(Note—Morning clinics at Passavant Memorial Hospital, afternoon clinics at Northwestern University Medical School.)

ST. LUKE'S HOSPITAL

L. L. MCARTHUR, S. W. MCARTHUR, H. E. JONES, C. A. HEDBLOM, SAMUEL PLUMMER, and W. B. FISK—9, daily. General surgical clinics.
LOUIS SCHMIDT and HARRY CULVER—9, daily. Genito-urinary clinics.
E. L. RYERSON, PHILIP LEWIN, R. O. RITTER, F. A. CHANDLER, and H. B. THOMAS—9, daily. Orthopedic clinics.
ARTHUR H. CURTIS and H. O. JONES—2, daily. Gynecological clinics.

COLUMBUS HOSPITAL

Monday

D. A. ORTH—2. Abdominal surgery.

Tuesday

FRED MUELLER—2. Orthopedic surgery.

Wednesday

M. J. SEIFERT and D. RUPP—9. Gastric surgery.

Thursday

DRS. WILLIAM and LENA SADLER—9. Gynecological surgery.

MERCY HOSPITAL

Monday

R. S. BERGHOFF—2. Differential diagnosis of chest diseases.

JOSEPH LAIBE—2. Urologic surgery; the relation of urology to gynecology.

P. H. KREUSCHER—2. Congenital dislocations of the hip; injection treatment of varicose veins.

Tuesday

L. D. MOOREHEAD—9. Surgery of the thyroid gland: Exophthalmic goiter, toxic adenoma, parenchymatous goiter, and mixed type of goiter.

J. F. GOLDEN—9. Abdominal surgery.

F. C. JACOBSEN—9. Fractures in industrial surgery.

J. B. O'DONOUGHUE—2. Tumors of breast, their surgical significance; clinical significance of reverse peristalsis of the upper intestinal tract, particularly in reference to gastrojejunal anastomosis; reaction of different classes of thyroid cases to surgery, and treatment of some unusual complications.

C. L. MARTIN—2. Polyps of the rectum and sigmoid; tuberculous ulcers of the sigmoid and rectum.

Wednesday

C. F. SAWYER—9. Pancreatitis—acute, subacute, and chronic; types of intestinal obstruction.

M. F. MCGUIRE—9. Treatment of diseases of the gall bladder and bile ducts; carcinoma of the colon.

J. E. KELLEY—9. The acute abdomen.

HENRY SCHMITZ—2. Early diagnosis and treatment of uterine and mammary cancers. Diagnosis and treatment of sterility due to blocked uterine tubes.

M. C. MULLEN—2. Toxemias of pregnancy.

Thursday

P. H. KREUSCHER—9. Treatment of advanced scoliosis; fractures involving the knee joint; fractures of the hip.

F. E. PIERCE—9. Fracture clinic.

F. M. DRENNAN, L. E. GARRISON, and C. F. SAWYER—2. Joint discussion on duodenal pathology with presentation of cases and the results of some experimental work; consideration of œsophageal stenosis by Dr. Drennan.

M. MANDEL—2. Pernicious anemia.

Friday

HENRY SCHMITZ—9. Gynecological surgery.

GEORGE GRIFFIN—9. Gastro-intestinal surgery.

J. D. CLARIDGE—9. Dislocation of internal semilunar cartilage.

W. S. BARNES—2. Gynecological clinic.

W. J. PICKETT—2. Fascial suture in the repair of hernia.

A. V. PARTIPILO—2. Closed aseptic gastro-intestinal anastomosis.

B. B. BEESON—2. Dermatological conditions which may become surgical.

MUNICIPAL TUBERCULOSIS SANITARIUM

Thursday

CARL A. HEDBLOM—9:30. Surgery of the chest in tuberculosis, operative clinic and demonstration of end-results.

Friday

CHARLES M. MCKENNA—9:30 Tuberculosis of the kidney, operative clinic and demonstration of pathologic types of renal tuberculosis.

BENJAMIN GOLDBERG and associates—2. Special measures in the general care of surgical tuberculosis.

MICHAEL REESE HOSPITAL

Tuesday

ALFRED A. STRAUSS. Stomach resection for gastric and duodenal ulcer; common duct duodenal anastomosis for recurrent gall stones.

HARRY JACKSON. Bone tumors and osteomyelitis.

D. C. STRAUSS. Thyroid surgery.

IRVIN S. KOLL. Pyelotomy for stone; nephrectomy for kidney tumor; urethral plastics.

JULIUS E. LACKNER. Abdominal hysterectomy; interposition operation; rectovaginal fistula.

W. H. RUBOVITS. Obstetrical demonstration of forceps, version and complete suture, episiotomy.

Wednesday

ALFRED A. STRAUSS. Gastric resection for ulcer and a complete colectomy and blood transfusion.

GEORGE L. DAVENPORT. General surgery; surgery of the central nervous system.

RALPH B. BETTMAN. Surgery of the chest.

J. S. EISENSTAEDT. Undescended testes and prostatectomy.

CHARLES M. JACOBS and DANIEL LEVENTHAL. Orthopedic surgery.

L. E. FRANKENTHAL. Gynecological operations.

Thursday

ALFRED A. STRAUSS. Stomach resection for gastric and duodenal ulcer and carcinoma of the colon.

GEORGE L. DAVENPORT. General surgery.

D. C. STRAUSS. Gall-bladder surgery.

JOSEPH L. BAER. Complete perineal laceration, ovarian tumor and pelvic inflammation.

IRVING STEIN. Obstetrical demonstration, low cervical cæsarean under local anæsthesia.

GUSTAV KOLISCHER. Bladder tumors.

HARRY C. ROLNICK. Prostatectomy.

Friday

ALFRED A. STRAUSS. Gastric resection for carcinoma and gall-bladder surgery.

GEORGE BETTMAN. General surgery of malignant tumors.

HELIODOR SCHILLER. General surgery, treatment of extensive carbuncle.

HARRY KATZ. Diverticulum of bladder.

ALFRED E. JONES. Spinal anæsthesia and prostatectomy.

JULIUS E. LACKNER and W. H. RUBOVITS. Sturmdorf-Wertheim operation for carcinoma of the cervix, plastic repair.

JOSEPH L. BAER and IRVING STEIN. Prolapse; vaginal hysterectomy; fibroids; occiput posterior.

MOUNT SINAI HOSPITAL

Tuesday

V. L. SCHRAGER—9. Abdominal surgery with special reference to interpretation and management of surgical risks.

Wednesday

I. E. BISKOW—9. Abdominal surgery.

A. E. KANTER—9. Vaginal plastics; hysterectomies.

Thursday

V. L. SCHRAGER—9. Abdominal surgery with special reference to interpretation and management of surgical risks.

L. HANDELMAN—9. General surgical operations.

Friday

J. MORA and B. A. WILLIS—9. Goiters; fractures.

M. BERNSTEIN—9. Orthopedic surgery: Synovectomies of knee; spinal fusion.

WESLEY MEMORIAL HOSPITAL

Monday

M. T. GOLDSTINE—2. Hysterectomy, vaginal plastics.

Tuesday

G. DE TAKATS—9. Varicose veins, spinal anæsthesia; thyroidectomy, local anæsthesia.
GUY S. VAN ALSTYNE—9. General surgery.
LOYAL DAVIS—2. Brain surgery.

Wednesday

R. W. MCNEALY—9. Hernias and blood vessel surgery.
ALLEN B. KANAVEL—9. General surgery.
JOHN A. WOLFER—9. Duodenal stasis and periduodenitis.
P. B. MAGNUSON and WILLIAM A. HENDRICKS—2. Plastic on hip; spinal fusion.

Thursday

EUGENE B. PERRY—9. Cystoplasties and kidney surgery.
O. S. PAVLIK—10. Hysterectomy and ovarian transplantation.
ALLEN B. KANAVEL—9. General surgery.
V. D. LESPINASSE—2. Genito-urinary surgery.
C. J. DEBERE—4. Rectal surgery.

Friday

R. W. MCNEALY—9. General surgery.
MICHAEL MASON—10. Dupuytren's contracture.
J. J. GILL—10. Obstetrical surgery; pathological obstetrics.
M. C. ERLICK—2. Hysterectomy, ovarian cysts.
P. B. MAGNUSON and WILLIAM A. HENDRICKS—2. Plastic on hip; spinal fusion.

AUGUSTANA HOSPITAL

Tuesday

NELSON M. PERCY—9. Thyroid clinic; general abdominal surgery; spinal anæsthesia.
R. J. ODEN—9. General surgery.

Wednesday

O. E. NADEAU—9. General urological surgery.
J. W. NUZUM—9. General surgery.
E. H. OCHSNER—9. General surgery.
D. W. CRILE—10. Orthopedic surgery.

Thursday

NELSON M. PERCY—9. Thyroid clinic; general abdominal surgery; spinal anæsthesia.
R. J. ODEN—9. General surgery.

Friday

O. E. NADEAU—9. General urological surgery.
J. W. NUZUM—9. General surgery.
E. H. OCHSNER—9. General surgery.
D. W. CRILE—10. Orthopedic surgery.

ST. ANTHONY DE PADUA HOSPITAL

Tuesday

LAWRENCE RYAN, FRED EHRMANN, STEPHEN DONLON, and JOSEPH ZABORTSKY—9. General surgical operations.
OTTO J. HIRSA—9. Genito-urinary surgery.
L. S. TICHY—9. X-ray demonstration.

Thursday

JOHN SPRAFKA, FRED OLLENTINE, FRANK JIRKA, and RALPH CUPLER—9. General surgical operations.
HARRY SMIJKL—9. Genito-urinary surgery.
MAX WEISKOPF—9. Obstetrics.
L. S. TICHY—9. X-ray demonstration.

PRESBYTERIAN HOSPITAL

Tuesday

ARTHUR DEAN BEVAN and associates—9. General surgical operations.
A. D. BEVAN, DR. GATEWOOD, and R. C. BROWN—9. Gall-bladder surgery.
N. SPROAT HEANEY, CAREY CULBERTSON, A. E. KANTER, E. D. ALLEN, and C. P. BAUER—9. Gynecology and obstetrics.
W. C. THOMAS—10:30. Blood chemistry and postoperative care.
A. D. BEVAN, DR. DAVIS, and V. C. DAVID—11. Surgery of large bowel.
A. H. MONTGOMERY—12. Intussusception.

Wednesday

ARTHUR DEAN BEVAN and associates—9. General surgical operations.
H. L. KRETSCHMER, R. H. HERBST, and associates—9. Genito-urinary surgery.
N. SPROAT HEANEY, CAREY CULBERTSON, A. E. KANTER, E. D. ALLEN, and C. P. BAUER—9. Gynecology and obstetrics.
WILBUR POST—10:30. Medical preparation of poor surgical risks for surgery.
A. D. BEVAN, CARL DAVIS, E. M. MILLER, and DR. LORING—11. Surgery of the thyroid.
ISABELLE HERBST—11:40. Anæsthesia in goiter.

Thursday

ARTHUR DEAN BEVAN and associates—9. General surgical operations.
KELLOGG SPEED—9. Bone surgery.
E. M. MILLER—9. Posterior dislocation of the shoulder.
A. H. PARMELEE—9. Diagnosis of acute osteomyelitis.
V. C. DAVID—9. Regeneration of bone in osteomyelitis.
R. C. WOODYATT—9. Preparation of diabetics for surgery.
GEORGE F. DICK—9. Erysipelas.
PETER BASSOE and W. J. POTTS—9. Charcot joints.
A. H. MONTGOMERY—9. Treatment of burns.
N. SPROAT HEANEY, CAREY CULBERTSON, A. E. KANTER, E. D. ALLEN, and C. P. BAUER—9. Gynecology and obstetrics.
H. A. OBERHELMAN—11. Surgical pathology.

Friday

ARTHUR DEAN BEVAN and associates—9. General surgical operations.
A. D. BEVAN, DR. GATEWOOD, R. C. BROWN, D. P. ABBOTT, and C. G. GRULEE—9. Surgery of the stomach.
N. SPROAT HEANEY, CAREY CULBERTSON, A. E. KANTER, E. D. ALLEN, and C. P. BAUER—9. Gynecology and obstetrics.
E. E. IRONS—10:30. Relation of focal infection to surgery.
DR. GATEWOOD—11. Subphrenic abscess.
F. B. MOOREHEAD—11:20. Surgery of the mouth and face.

RUSH MEDICAL COLLEGE

Tuesday

CARL DAVIS—11. Surgical clinic.

Wednesday

N. S. HEANEY—11. Gynecological clinic.

Thursday

A. D. BEVAN—11. Surgical clinic.

Friday

CARL DAVIS—11. Surgical clinic.

RESEARCH AND EDUCATIONAL HOSPITAL

Monday

H. B. Thomas—2. Orthopedic surgery.

Tuesday

Carl A. Hedblom—10. Thoracic surgery.

Wednesday

Jerome R. Head—10. Neurological surgery.
F. H. Falls—2. Gynecology and obstetrics.

Thursday

J. D. Koucky—10. General surgery.

Friday

Lindon Seed—9. Thyroid surgery.
Louis Schultz—10. Oral surgery.
F. H. Falls—2. Gynecology and obstetrics.

EVANGELICAL DEACONESS HOSPITAL

Tuesday

Edward M. Heacock—9. Operative treatment of uterine fibroids.

Wednesday

A. J. Schoenberg—9. Carcinoma of the cervix uteri.
F. O. Bowe—2. Placenta prævia and management of its complications.

Thursday

C. v. Bachelle—9. Operations for ulcer of the stomach and duodenum.
L. H. Friedrich—2. Management of the complications of gonorrhea.

Friday

Paul F. Morf—9. Gall bladder disease and its operative treatment.
Elmer W. Mosley—2. Cæsarean section in contracted pelves.

LUTHERAN DEACONESS HOSPITAL

Tuesday

John D. Koucky—9. General surgical clinic, operations and demonstrations of cases.
Lindon Seed—9. Thyroid clinic, operations and demonstration of cases.
George H. Schroeder—9. General surgical clinic, operations and demonstration of cases.

Thursday

John D. Koucky—9. General surgical clinic, operations and demonstration of cases.
Lindon Seed—9. Thyroid clinic, operations and demonstration of cases.
George H. Schroeder—9. General surgical clinic, operations and demonstration of cases.

WASHINGTON BOULEVARD HOSPITAL

Tuesday

Arthur R. Metz—9. Fracture clinic.

Wednesday

Vincent J. O'Conor—9. Urological clinic.

Thursday

Paul C. Fox—9. Gynecological clinic.

JOHN B. MURPHY HOSPITAL

Monday

Henry R. Kenny. Surgery of bones and joints; arthrodesis of the knee.
William Gehl. Renal function test; urological surgery.
F. H. Kampf. Hallux valgus.

Tuesday

M. J. Purcell. Fracture clinic.
Gustav Brandle. Operative treatment of cranial injuries.
A. C. Slinde. Conservative surgery for hydronephrosis.
S. S. McNeil. Plastic operations on hand and face.

Wednesday

Arnold H. Kegel. Thyroid clinic, operation and demonstration of cases.
E. V. J. Young. Operative treatment of old fracture of the os calcis.
James Larkin. Radium treatment of carcinoma of cervix.

Thursday

William Gehl. Two-stage suprapubic prostatectomy.
Joseph Cunningham. Management of the eclamptic patient.
John Wallner. Diagnosis and management of sterility.
J. Wilson Grimes. Surgical treatment of pulmonary tuberculosis.
L. C. McDermott. Cæsarean section.

Friday

A. C. Garvey. Surgical treatment of ulcers of the stomach.
J. M. Hamilton. Surgery of the nervous system.
F. O. Bowe. Tendon grafting.
James J. McGuinn. Carcinoma of the colon and sigmoid.
J. E. Leo. Surgery of the gall bladder and common duct.

ILLINOIS CENTRAL HOSPITAL

Tuesday

C. H. Phifer—9. Dry clinic: Abdominal surgery.
Faris Chesley—10. Medical aspects of acute abdomen.

Wednesday

W. T. Harsha—9. Thyroid clinic.
L. Sloan—10. Medical aspects of toxic goiter.
A. H. Baugher—11. Pathology of toxic goiter.

Thursday

Hugh MacKecknie—9. Dry clinic: general surgery.
J. C. Delprat—10. Dry clinic: general surgery.
Beveridge Moore—11. Orthopedic surgery.
William Culpepper—11. X-ray demonstration of pathology of Paget's disease.

Friday

W. T. Harsha and C. C. Guy—9. Dry clinic: General surgery.
William Hewitt—10. Dry clinic: Gynecology and obstetrics.

ALEXIAN BROTHERS' HOSPITAL

E. W. White, Edward Hess, A. Wochinski, C. O. Rotch, Alf Holm, and J. Glasser—9, daily. Genito-urinary clinic.
M. L. Harris, August Zimmerman, and Daniel Murphy—9, daily. General surgical clinic.
Ralph Wheeler, William Swift, Frank Baylor, and K. I. Stevens—9, daily. Fracture clinic.

WEST SIDE HOSPITAL

Tuesday

C. R. G. FORRESTER and H. C. LYMAN—9. Fracture clinic, local anæsthesia in reduction of fractures.
E. W. BROWN—11. Surgery of gastric and duodenal ulcers.
P. C. GEORGAN—2. Abdominal surgery, management of intestinal obstruction.

Wednesday

J. S. NAGEL—9. Prostatectomies; demonstration of functional tests in renal surgery; neoplasms of the kidney.
G. F. THOMPSON—9. Surgery of the bile tracts.
S. G. WEST—11. Vaginal hysterectomy; vaginal route in pelvic surgery.

Thursday

C. R. FORRESTER and H. C. LYMAN—9. Results of air insufflation in treatment of sequela of cranial injuries; operative treatment of recent and old bone and joint injuries.
C. C. O'Byrne—11. Goiter clinic.
A. M. HARVEY and J. H. CHIVERS—2. Industrial surgery.

Friday

A. N. CLAGGETT—9. Radium in the treatment of malignant disease, demonstration of cases.
C. G. SCHUESTZER—11. Genito-urinary surgery: Cystoscopies, renal catheterization and X-ray demonstration, treatment of hydronephrosis.

SOUTH SHORE HOSPITAL

Monday

FREDERICK RAHE—2. General surgical clinic.
ETHELBERT LUTTON—3. General surgical clinic.

Tuesday

HUGH MACKECHNIE—9. General surgical clinic.
LOUIS D. SMITH—11. Genito-urinary surgery.
MARTIN MERBITZ—2. General surgical clinic.

Wednesday

GUY VAN ALSTYNE—9. General surgical clinic.
GEORGE G. O'BRIEN—11. General surgical clinic.
EDMOND PROBY—2. General surgical clinic.

Thursday

WELLER VAN HOOK—9. General surgical clinic.
AXEL WERELIUS—10:30. General surgical clinic.
EDWARD MASTERTON—2. General surgical clinic.

Friday

FRANK MEAD—9. General surgical clinic.
PAUL ROSBOROUGH—10. General surgical clinic.
FRANK MURPHY—11. Fracture clinic.
LESLIE BLACKWOOD—2. General surgical clinic.

GRANT HOSPITAL

Tuesday

A. G. FRYE—9. General surgical clinic.
D. A. ZIMMERMAN—11. General surgical clinic.

Thursday

D. A. ZIMMERMAN—11. General surgical clinic.

Friday

S. COOMBS—9. General surgical clinic.

UNIVERSITY HOSPITAL

Tuesday

ADOLPH KRAFT—9. Suppuration about the diaphragm.
GEORGE M. LANDAU—10. Pathological aspects of the lung from a roentgenological standpoint.
MAX MEYEROVITZ—11. Surgical conditions of Meckel's diverticulum.

Wednesday

HARRY SINGER—9. Demonstration of gastro-intestinal specimens.
KARL A. MEYER—10. Gastro-intestinal surgery.

Thursday

ARTHUR H. CONLEY—9. Calcium and phosphorous metabolism in fractures.
CHARLES DAVISON—10. Surgery of autogenous bone transplants.

Friday

O. H. ROHRLACK—9. Surgical obstetrics.
MARSHALL DAVISON—10. Surgery of undescended testes.

CHICAGO MEMORIAL HOSPITAL

Monday

VANCE RAWSON—2. Cardiovascular disease and surgery.
CHARLES J. DRUECK—3. Diverticulitis.

Tuesday

ARTHUR E. MAHLE—9. Management of the thyroid patient.
PETER S. CLARK—9. Surgery of the thyroid.
JULIA C. STRAWN—2. Surgical gynecology.
JAMES E. FITZGERALD and M. RUTH MCGUIRE—3:30. Surgical obstetrics.

Wednesday

BENNETT R. PARKER—9. Surgery of the gall bladder and bile tract.
J. W. PARKER—9. Hydronephrosis and hypernephroma.
ROBERT A. MELENDY—2. Empyema and allied conditions.
GEORGE L. BROOKS and ROBERT A. MELENDY—4. Surgery in diabetics.

Thursday

CHARLES E. KAHLKE—9. Surgery of the stomach and duodenum.
PAUL M. CLIVER—2. Fractures, general management, operation, treatment and results.
CHARLES J. DRUECK—3. Unusual rectal fistulas.
M. L. WEINSTEIN—4. Gall-bladder surgery under local anæsthesia.

Friday

LAWRENCE L. ISEMAN—9. The cancer problem.

LUTHERAN MEMORIAL HOSPITAL

Tuesday

CHARLES F. STOTZ—9. General surgical clinic.

Wednesday

ARTHUR G. FREY—9. General surgical clinic.

Thursday

CHARLES F. STOTZ—9. General surgical clinic.

Friday

ARTHUR G. FREY—9. General surgical clinic.

RAVENSWOOD HOSPITAL

Monday

G. W. GREEN—2. Gallstone clinic.
G. N. BUSSEY—2. Abdominal hysterectomy, fibroids.
G. DE TARNOWSKY—2. Hemorrhagic colitis.

Tuesday

C. A. BUSWELL—9. Carcinoma of the cervix uteri.
D. B. POND—9. Fracture clinic.
R. E. DYER—9. Fallopian tube visualization with lipiodol.
W. F. GROSVENOR, C. C. RENTFRO, and F. W. ROHR—2. Obstetrical conference.

Wednesday

E. B. WILLIAMS—9. Abdominal hysterectomy, fibroids.
P. J. SARMA—9. Abdominal wall incisions based on physiologic grounds.
F. VON NAHOWSKI—9. Hepatic abscess.

Thursday

L. WILDER—9. Goiter cases.
E. W. MUELLER—9. Treatment of burns.
W. F. GROSVENOR, C. C. RENTFRO, and F. W. ROHR—2. Obstetrical conference.
G. DE TARNOWSKY—9. Ruptures of urinary bladder.

Friday

G. W. GREEN—9. Surgical clinic.
A. G. SCHROEDER—9. Surgical clinic.

ST. BERNARD'S HOSPITAL

Monday

WILLIAM EPSTEIN—2. Goiter clinic.
G. M. CUSHING—2. Gall-bladder clinic.

Tuesday

WILLIAM HECTOR—9. Surgical clinic.
L. B. DONKLE—9. Surgical clinic.
CHESTER GUY—2. Laboratory demonstrations.
J. A. PARKER—2. Surgical clinic.

Wednesday

J. B. HAEBERLIN—9. Surgical clinic.
EMIL RACH—2. Obstetrical clinic.
B. C. CUSHWAY—2. Radium cases.

Thursday

J. T. MEYER—9. Surgical clinic.
W. H. BOHART—9. Industrial surgery.
J. G. FROST—2. Fracture clinic.

CHILDREN'S MEMORIAL HOSPITAL

Monday

JOHN A. GRAHAM—1. The acute abdomen.

Tuesday

JAY IRELAND—11. The treatment of empyema in children.

Wednesday

FREDERICK B. MOOREHEAD—9. Cleft lip and cleft palate; cartilage transplants for the correction of facial deformities.

Thursday

ALBERT H. MONTGOMERY—9. Pyloric stenosis and intussusception; general surgery of children.

ALBERT MERRITT BILLINGS HOSPITAL

Monday

LESTER DRAGSTEDT—2. Abdominal surgery, intestinal obstruction.

Tuesday

PERCIVAL BAILEY—9. Surgery of the spinal cord.
D. B. PHEMISTER, L. DRAGSTEDT, G. M. CURTIS, and C. B. HUGGINS—9. Surgical operations.

Wednesday

D. B. PHEMISTER—9. Surgery of bones and joints.
P. BAILEY, G. M. CURTIS, L. DRAGSTEDT, and C. B. HUGGINS—9. Surgical operations.

Thursday

G. M. CURTIS—9. Surgical operations.
D. B. PHEMISTER, P. BAILEY, L. DRAGSTEDT, and C. B. HUGGINS—9. Surgical operations.

Friday

C. B. HUGGINS—9. Genito-urinary operations.
D. B. PHEMISTER, P. BAILEY, G. M. CURTIS, and L. DRAGSTEDT—9. Surgical operations.

CHICAGO LYING-IN HOSPITAL

Monday

JOSEPH B. DE LEE—2. Motion pictures of laparotrachelotomy.

Tuesday

D. A. HORNER and L. E. NADELHOFFER—9. Obstetrical clinic.
A. R. LAPHAM—2. Obstetrical clinic.

Wednesday

J. P. GREENHILL and M. E. DAVIS—9. Obstetrical clinic.

Thursday

E. L. CORNELL and M. P. URNES—9. Obstetrical clinic.

Friday

J. H. BLOOMFIELD and H. BUXBAUM—9. Obstetrical clinic.

SHRINERS' HOSPITAL

Monday

B. H. MOORE—2. Ward visit: demonstration of apparatus in use.

Tuesday

B. H. MOORE—9. Orthopedic operations; use of ethylene anæsthesia for children.
MR. DREHER—2. Demonstration of braces and special apparatus.

Wednesday

B. H. MOORE and associates—2. Demonstration of plaster technique.

Thursday

B. H. MOORE—9. Orthopedic operations.
B. H. MOORE—2. Moving pictures.

Friday

B. H. MOORE—9. X-ray demonstration of unusual conditions.
B. H. MOORE—2. Results in orthopedic cases.

ILLINOIS MASONIC HOSPITAL

Tuesday

JOHN R. HARGER—9. Infection of upper abdomen.
ROBERT H. HAYES—10. Infection of the lungs.
B. H. HUGGINS—11. Arthritis.

Wednesday

GILBERT FITZPATRICK—9. Obstetrical surgery.
WILLIAM H. GILMORE—10. Pelvic trauma.
JOHN P. SPRAGUE—11. Orthopedic clinic.

Thursday

HUGH N. MACKECHNIE—9. Gastro-intestinal surgery.
EDWARD A. WHITE—10. Genito-urinary clinic.
BAYARD HOLMES—11. Myocarditis and surgery.

Friday

MORRIS BLATTS—11. Thymus disease.

NORTH CHICAGO HOSPITAL
(At Grant Hospital)

Tuesday

FREDERICK HARVEY—9. Fracture clinic, with special reference to fractures about the ankle and elbow.

Wednesday

CARL BECK—9. Plastic surgery of the hands and fingers.

Thursday

FREDERICK HARVEY—9. Thyroid clinic.

Friday

CARL BECK—9. Hypospadias.

LAKE VIEW HOSPITAL

Tuesday

H. P. SAUNDERS—9. Surgery of the gall bladder, demonstration of cases.
B. C. CORBUS—2. Bladder tumors.

Wednesday

ANDRE L. STAPLER—2. Thyroidectomies, toxic adenoma, with spinal block; hysterectomies, fibroids, with spinal anæsthesia.

Thursday

JOHN W. BIRK—9. Obstetrical clinic, presentation of pathological cases.
WALTER S. SIEWERTH—2. Surgical correction of pathology of female genitalia.

JACKSON PARK HOSPITAL

Tuesday

ARRIE BAMBERGER, A. HENNING, and associates—9. General surgery.
S. B. MACLEOD—2. Traumatic surgery.

Wednesday

ARRIE BAMBERGER, A. HENNING, and associates—9. General surgery.

Thursday

ARRIE BAMBERGER, A. HENNING, and associates—9. General surgery.

Friday

S. B. MACLEOD—2. Traumatic surgery.

WASHINGTON PARK COMMUNITY HOSPITAL

Tuesday

C. C. CLARK—9. Thyroid operation; carcinoma of breast.
H. H. COX—9. Cholecystectomy; hemorrhoids.
Y. JORANSON—2. Blood transfusion; spinal anæsthesia.
F. P. HAMMOND—2. Hernia, recurrent and ventral; management of fracture about ankle.

Wednesday

S. C. HOGAN—9. Gastric resection; gall-bladder surgery.
L. B. BELL—9. Cholecystectomy; posterior gastro-enterostomy.
C. C. COX—2. Hysterectomy; carcinoma of breast; thyroid.
C. C. CLARK—2. Hernia; gastro-enterostomy.

Thursday

F. P. HAMMOND—9. Osteomyelitis; empyema.
Y. JORANSON—9. Goiter; gastro-enterostomy.
L. B. BELL—2. Appendectomy; hemorrhoidectomy.
S. C. HOGAN—2. Hysterectomy; thyroid.

POST GRADUATE HOSPITAL

Tuesday

L. GLASSMANN—9. Prolapse of the uterus.
W. SCHAARE—10. Colles fracture.

Wednesday

LEO ZIMMERMAN—10. Vascular diseases of the extremities.
W. A. N. DORLAND—2. Repair of perineum.

Thursday

H. L. MEYERS—9. Hysterectomy.
R. W. HARDON—10. Injection treatment of varicose veins.
EMIL RIES—2. Enterocele vaginalis.

Friday

EMIL RIES—10. Precancerous lesions of cervix uteri.
M. MABEE—2. Treatment of leucorrhea.

ST. JOSEPH'S HOSPITAL

Tuesday

FRANK DAVID and C. J. DEBERE—9. Rectal surgery.
W. H. G. LOGAN—9. Oral surgery.
CHARLES MCKENNA—9. Genito-urinary surgery.
HUGH MCKENNA, OSCAR OPNER, DAVID FITZGERALD, and GEORGE FITZGERALD—9. General surgery.
F. B. MCCARTY, E. P. CARROLL, and JOHN BOLAND—9. General surgery.
CHARLES SCHOTT—9. Results of Rammstedt operations for pyloric stenosis in infants.
L. E. HINES—9. Demonstration of laboratory work as applied to surgery.
W. F. GROSVENOR, H. BUXBAUM, L. W. MARTIN, T. J. O'DONOGHUE, F. W. ROHR, and G. COTTS—11. Gynecology.

HENROTIN MEMORIAL HOSPITAL

Tuesday

CHANNING W. BARRETT—9. Gynecological clinic.

Wednesday

WILLIAM M. THOMPSON—2. Management of abdominal and pelvic adhesions.

SURGERY OF THE EYE, EAR, NOSE, AND THROAT

ILLINOIS EYE AND EAR INFIRMARY

Monday

MAYER H. LEBENSOHN and EDWARD H. GARRAGHAN—2. Plastic surgery of eyelids.
U. J. GRIM—2. Mastoid.

Tuesday

HERBERT S. WALKER—2. Ocular muscles.
MICHAEL GOLDENBURG—2. Some late phases of glaucoma.
OSCAR CLEFF—2. Mastoid.
CHARLES F. YERGER—2. Radical nasal sinus operations.

Wednesday

DWIGHT C. ORCUTT and ROBERT H. BUCK—2. Ocular muscles and operative trachoma.
HENRY BOETTCHER—2. Tonsils and mastoid.

Thursday

EPHRAIM K. FINDLEY—2. Cataract operations.
EDWARD N. SCHOOLMAN—2. Bronchoscopy and plastic surgery.

Friday

E. R. CROSSLEY—2. Cataract operations.
ALFRED LEWY—2. Nasal sinuses and mastoid.

RUSH MEDICAL COLLEGE

Monday

WILLIAM G. REEDER—3. Ophthalmological clinic.

Tuesday

EARLE B. FOWLER—3. Ophthalmological clinic.

Wednesday

T. D. ALLEN—2. Ophthalmological clinic.

Thursday

WILLIAM G. REEDER—3. Ophthalmological clinic.

Friday

BERTHA KLEIN—3. Ophthalmological clinic.

PRESBYTERIAN HOSPITAL

Monday

DANIEL HAYDEN—2. Ear, nose and throat clinic.

Tuesday

EDWIN MCGINNIS—2. Ear, nose and throat clinic.
WILLIAM H. WILDER—4. Eye operations.

Wednesday

GEORGE E. SHAMBAUGH—2. Ear, nose and throat clinic.

Thursday

EDWIN MCGINNIS—2. Ear, nose and throat clinic.

ST. LUKE'S HOSPITAL

Tuesday

JOHN A. CAVANAUGH and EDWARD P. NORCROSS. Nose and throat clinics.

Friday

JOHN A. CAVANAUGH and EDWARD P. NORCROSS. Nose and throat clinics.

COOK COUNTY HOSPITAL

Monday

JAMES P. FITZGERALD—3. Fundus clinic.

Tuesday

WILLIAM F. MONCRIEF—10. Diagnostic and operative eye clinic.
THOMAS J. GALLOWAY—10. Diathermy and malignancies of the mouth and throat.
CHARLES F. YERGER—2. Ophthalmoscopic and surgical clinic.

Wednesday

JAMES P. FITZGERALD—2. Ophthalmoscopic and surgical clinic.
S. SALINGER and S. PEARLMAN—2. Diagnostic clinic; nasal plastic surgery.

Thursday

GEORGE W. BOOT—9. Bronchoscopic clinic.
CHARLES F. YERGER—2. Ophthalmoscopic and surgical clinic.
JAMES P. FITZGERALD—3. Fundus clinic.

Friday

JAMES P. FITZGERALD—2. Ophthalmoscopic and surgical clinic.

NORTHWESTERN UNIVERSITY MEDICAL SCHOOL

Monday

L. A. SHIPFER and E. E. DILLON. Chronic suppurative otitis media treated with zinc ionization.
JOHN DELPH. Endoscopy.

Tuesday

C. F. BOOKWALTER. Demonstration of intranasal tear sac operation.

Wednesday

OTIS MACLAY. Sinus work.
WILLIAM JOYCE. Demonstration of plastic flap used in radical mastoid operation.

Thursday

CHARLES B. YOUNGER. Atrophic rhinitis.

Friday

R. D. RUSSELL. Demonstration of endolymphatic sac and valve.
ELLISON L. ROSS. Vestibular reaction as affected by drugs.

JOHN B. MURPHY HOSPITAL

Monday

G. W. MAHONEY. Emergency surgery of the eye; industrial injuries.

Tuesday

EDWARD GARRAGHAN. Operations for acute glaucoma.

Wednesday

S. SCIARRETTA. Indications for operative treatment in acute mastoiditis.

EYE, EAR, NOSE AND THROAT HOSPITAL

Monday

A. R. HOLLENDER—2. Physical therapy clinic; practical demonstration of the application of electrotherapy to the eye, ear, nose and throat.
T. S. KAMMERLING—2. Eye clinic.
H. B. FULLER—2. Ear, nose and throat clinic.
IGNAZ SOMMER—4:30. Intracranial relation to ear, nose and throat.

Tuesday

H. B. FULLER and D. C. BROWN—9. Ear, nose and throat surgical clinic.
O. B. NUGENT—11. Surgical treatment of chronic dacrocystitis.
W. A. FISHER—2. Simplified Barraquer operation for cataract extraction.
R. CASTROVIEJO—4. Demonstration of various methods of ophthalmoscopy (simplified Gullistrand, giant Gullistrand, red free light, direct and indirect).

Wednesday

T. S. KAMMERLING and L. SAVITT—9. Ear, nose and throat surgical clinic.
O. B. NUGENT—11. Photography as applied to the practice of ophthalmology. Demonstration of making of photographic records in ocular diseases; in plastic surgery. Anterior stereopticon camera; fundus photography; making of lantern slides; photomicroscopy. Motion pictures.
T. S. KAMMERLING—2. Eye clinic.
H. B. FULLER—2. Ear, nose and throat clinic.
IGNAZ SOMMER—4:30. Tuning forks.

Thursday

O. B. NUGENT—9. Cataract clinic: Cataract extraction by simplified Barraquer method; teaching of cataract extraction by motion pictures.
R. CASTROVIEJO—11. Practical demonstration of slit-lamp microscopy.
H. B. FULLER—2. Eye clinic.
T. S. KAMMERLING—2. Ear, nose and throat clinic.
IGNAZ SOMMER, R. CASTROVIEJO, and E. GALLARDO—2. Demonstration of various laboratory methods and the practical application of clinical findings.
R. CASTROVIEJO—4:30. Histopathology.

Friday

H. B. FULLER, T. S. KAMMERLING and O. M. STEFFENSON—9. Ear, nose and throat surgical clinic.
H. W. WOODRUFF—11. Deep iridectomy for glaucoma; tucking operation for strabismus.
T. S. KAMMERLING—2. Eye clinic.
H. B. FULLER—2. Ear, nose and throat clinic
IGNAZ SOMMER—4:30. The rôle of the nasal accessory sinuses in nasal diseases.

LAKE VIEW HOSPITAL

Monday

FRANK J. NOVAK, JR.—2. Suspension laryngoscopy.

Wednesday

ROBERT H. BUCK—9. Demonstration of various eye operations.

CHILDREN'S MEMORIAL HOSPITAL

Tuesday

MORRIS COTTLE—9. Surgical and non-surgical ear diseases in infancy.

RESEARCH AND EDUCATIONAL HOSPITAL

Monday

FRANCIS L. LEDERER, JOHN J. THEOBALD, and OSCAR VAN ALYEA—2. Otolaryngological clinic.

Tuesday

HALLARD BEARD—9. Surgery of squint; tucking and tenotomy.
NATHAN SCHNECK—10. Otolaryngological clinic.
SHERMAN SHAPIRO and ARTHUR J. COOMBS—2. Otolaryngological clinic.
FRANCIS L. LEDERER—2. Otolaryngological operations.

Wednesday

I. G. SPIESMAN—10. Otolaryngological clinic.
FRANCIS L. LEDERER, WALTER H. THEOBALD, and JOHN J. THEOBALD—2. Otolaryngological clinic.

Thursday

GEORGE S. LIVINGSTON—10. Otolaryngological clinic.
SHERMAN SHAPIRO and ARTHUR J. COOMBS—2. Otolaryngological clinic.
JOHN J. THEOBALD—2. Otolaryngological operations.

Friday

MAX L. FOLK and SAUL C. GREENWALD—9. Plastic operations on the eyelids.
J. HARNED—10. Otolaryngological clinic.
FRANCIS L. LEDERER—2. Otolaryngological clinic.

MICHAEL REESE HOSPITAL

Monday

M. L. FOLK—2. Diagnosis and treatment of iritis.

Tuesday

SAMUEL J. MEYER—2. Operations for glaucoma.

Wednesday

ROBERT VON DER HEYDT—2. Slit-lamp microscopy of the living eye.

Thursday

S. C. GREENWALD—2. Operations for strabismus.

Friday

ROBERT VON DER HEYDT—2. Photography of the anterior segment of the eye.

MOUNT SINAI HOSPITAL

Wednesday

NOAH SCHOOLMAN, JACOB LIFSCHUTZ, and associates—9. Bronchoscopy and lipiodol injections in pulmonary conditions; œsophagoscopy.
NOAH SCHOOLMAN, JACOB LIFSCHUTZ, and associates—2. Lipiodol studies and operations on accessory sinuses; X-ray studies and operations for ear conditions.

WASHINGTON BOULEVARD HOSPITAL

Tuesday

LINN F. MCBRIDE—2. Nose and throat clinic.

Wednesday

CASSIUS and VIRGIL WESCOTT—2. Eye clinic.

Thursday

LINN F. MCBRIDE—2. Nose and throat clinic.

ILLINOIS CENTRAL HOSPITAL

Tuesday

J. H. McLaughlin—9. Ear, nose and throat clinic.
H. J. Smith—9. Emergency surgery of the eye, industrial injuries.

Wednesday

J. H. McLaughlin—9. Ear, nose and throat operative clinic.
H. J. Smith—9. Emergency surgery of the eye, industrial injuries.

Thursday

J. H. McLaughlin—9. Ear, nose and throat clinic.
H. J. Smith—9. Emergency surgery of the eye, industrial injuries.

Friday

J. H. McLaughlin—9. Ear, nose and throat operative clinic.
H. J. Smith—9. Emergency surgery of the eye, industrial injuries.

WEST SIDE HOSPITAL

Wednesday

W. L. Noble—9. Surgery of the eye.

Thursday

J. A. Clark and A. E. Lund—9. Tonsillectomies.

EVANGELICAL DEACONESS HOSPITAL

Monday

Arthur Geiger—2. Deflections of the nasal septum.

Tuesday

G. Thompsen von Colditz—2. Types of tonsil operations.

CHICAGO MEMORIAL HOSPITAL

Monday

Richard H. Street—4. Tonsillectomies under local and general anæsthesia.

Tuesday

Alfred E. Lewy and Richard W. Watkins—3. Mastoids.
Irving I. Muskat—4. Plastic surgery.

WESLEY MEMORIAL HOSPITAL

Monday

T. P. O'Connor—2. Ear, nose and throat clinic, operations.

Tuesday

Gordon Wilson—9. Otological surgery.

ILLINOIS MASONIC HOSPITAL

Friday

T. J. Williams—9. Otolaryngological clinic.
W. S. Boynton—10. Scientific exactness in the differential diagnosis and operative treatment of strabismus.

ST. JOSEPH'S HOSPITAL

Tuesday

Austin A. Hayden, Jacques Holinger, and E. W. Gardner—2. Eye, ear, nose and throat clinic, accessory nasal sinuses.

POST GRADUATE HOSPITAL

Monday

J. Hayden—2. Accessory sinuses.

Tuesday

S. Sher—11. Benign growth of vocal cord.
B. Cushman—2. Trephine for glaucoma.
W. M. Wolin—3. Septum and tonsils.

Wednesday

E. Stewart—9. Glaucoma.

Friday

S. Wiener—9. Nasal polyps and accessory sinuses.

NORTH CHICAGO HOSPITAL
(At Grant Hospital)

Tuesday

Harry L. Pollock—9. Surgical treatment of acute mastoiditis.

Wednesday

Joseph Beck—9. Surgical treatment of carcinoma of the larynx.

Thursday

Harry L. Pollock—9. Intranasal surgery.

Friday

Joseph Beck—9. Pathology of the ear, nose and throat.

ALBERT MERRITT BILLINGS HOSPITAL

Monday

D. Katz—2. Eye clinic.

Thursday

Louis Bothman-9. Eye clinic.

COLUMBUS HOSPITAL

Tuesday

C. O. Lindstrom—9. Mastoiditis and various types of tonsillectomies.

Wednesday

L. R. Mellen—9. Plastics on nose.

RAVENSWOOD HOSPITAL

Friday

A. N. Murray and W. J. Noonan—2. Otolaryngological clinic.

GARFIELD PARK HOSPITAL

Wednesday

R. H. Good and L. B. Phelps—9. Eye and ear clinic.

MUNICIPAL TUBERCULOSIS SANITARIUM

Thursday

Francis Lederer—2. Tuberculosis of the larynx and bronchoscopy demonstrations.

GRANT HOSPITAL

Tuesday

O. Krast—9. Eye clinic.